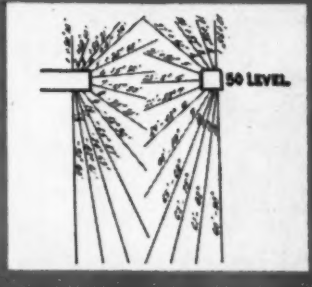
MINING WORLD

JUNE 1959
VOL. 21 NO. 7

New Projects at Kennecott . . . . . p. 30

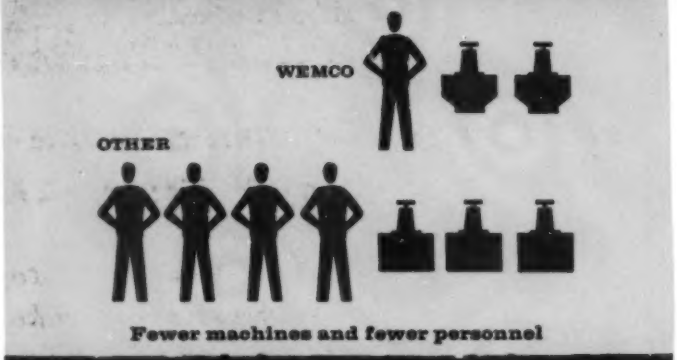
Kermac's New Uranium Mill . . . . p. 48



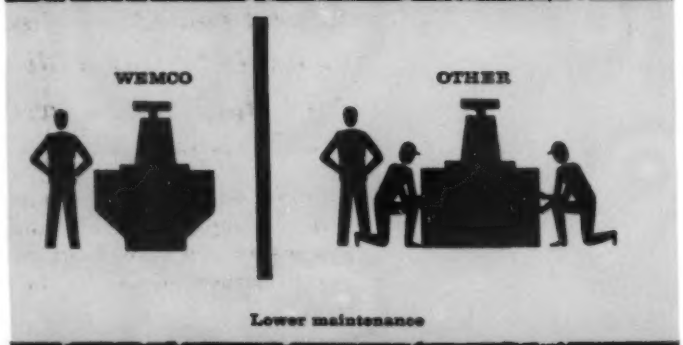
Sub Level Stoping at Geco . . . . . p. 40

100 Years on the Comstock Lode . . . p. 46

LABOR REQUIREMENTS REDUCED, MAINTENANCE COSTS CUT... WITH WEMCO-FAGERGREN FLOTATION



Fewer machines and fewer personnel



Lower maintenance

Wemco-Fagergren equipment costs less, *much* less, to operate! Operating labor is reduced because Fags need little or no adjustment to compensate for feed variations. Simplicity of design and operation assures fewer maintenance problems—and less cost. There is less wear and replacement of parts, less downtime because wear-exposed parts are rubber covered and an entire mechanism is easily removed for inspection and repair without shutdown of pulp flow.

This proved economy plus greater recovery adds up to consistent, profitable operation under the most demanding conditions! If flotation will do the job, Wemco-Fagergrens will do the job better, at less cost! Ask for complete information.

WEMCO

a division of
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"40% more usable life—more resharpenings!"
"Bit and rod life are well above average!"
"Uncouple by hand all the time!"
"More rigid—drills straighter holes!"*

**Names of men quoted available on request*

The comments above are actual quotes from project managers, job superintendents, and drill superintendents who have tested new Coromant rope-thread bits and steels. They've learned, on-the-job, the benefits they—and you—can expect!

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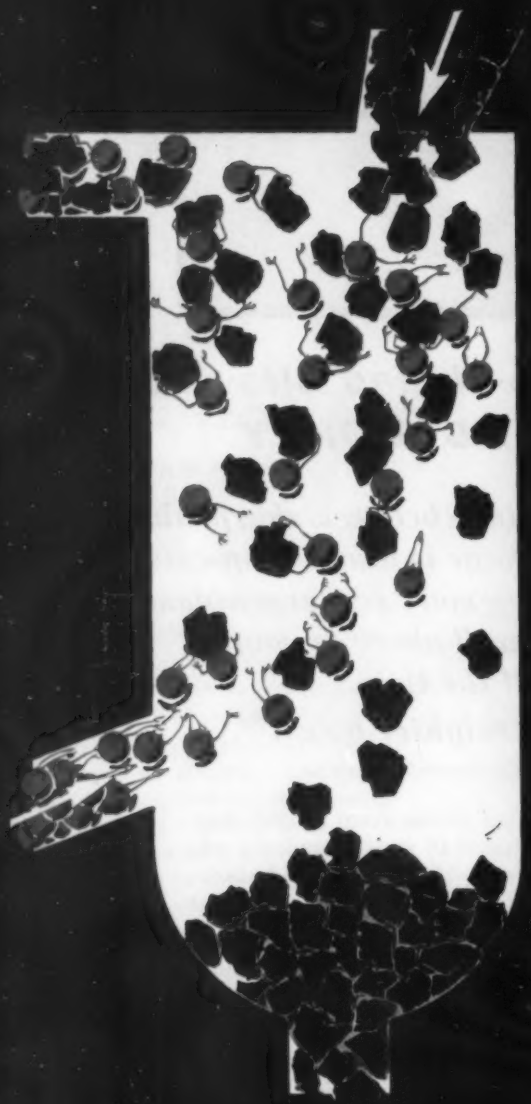

Helps reduce costs and increases operating efficiency by:

1. **Reducing corrosion**

   The spherical shaped particles of atomized ferrosilicon offer maximum resistance to corrosion due to their smooth, hard surface. There are no sharp-edged corners which are particularly susceptible to rusting.

2. **Reducing „drag-out" or adhesion losses**

   Atomized ferrosilicon particles are easily separated from the ore and gangue by spraying on the rinsing screens, eliminating high losses due to adhesion.

3. **Reducing pulp viscosity**

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4. **Reducing wear on equipment**

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Mining World

Including the Export Edition **WORLD MINING**

Published monthly except in April when publication is semi-monthly

VOLUME 21 **JUNE 1959** **No. 7**

OPERATIONS—TECHNOLOGY

Ore Dressing & Smelting

Three New Projects at Kennecott Copper **30**

An introduction to a three part feature describing new metallurgical projects at Kennecott's Ray Mines Division. All were designed to improve efficiency.

1. L-P-F Was The Key to Greater Copper Recovery **31**

Kennecott modified the Hayden, Arizona, mill to provide for the installation of a leach-flotation-precipitation process. It increased the copper recovery by 2 pounds per ton treated.

2. How Sponge Iron Is Produced For Mill **33**

Kennecott's Hayden mill recovers a pyrite as a flotation concentrate. The pyrite is used to feed a fluid bed reactor which produces hematite calcines for a Bruckner furnace.

3. Kennecott's New Smelter at Ray Mines Division **36**

It was designed for green smelting practice and can handle up to 1,000 dry tons of copper concentrate per day.

Mining

Sub Level Blasthole Stoping at Geco **40**

In Canada Geco designed a mine to recover a copper-zinc orebody. It features gravity transfer of ore from stope scrams to a conveyor level.

Virginia City Celebrates the Comstock Centennial **46**

Modern square set mining had its origin in Nevada's famous Comstock lode.

Hydrometallurgy

Kermac Dedicates New Uranium Mill **48**

This solvent extraction mill has four new design features and is the world's largest plant employing SX.

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MILLER FREEMAN PUBLICATIONS

GRAB SAMPLES From the Mail

Not A Single Assessment Made

Dear Sir:

As former president and former manager of Lucky Friday Silver-Lead Mines Company, we are grateful for the honor which you have paid the Lucky Friday company in selecting that company as "the small mining company of 1958." Modesty prevents us from trying to justify the award. But we are proud of it. We know, of course, that *luck* plays a big part in the mining business. And we acknowledge that luck played a big part in the development of the Lucky Friday mine. It took a bunch of amateurs to take over an old abandoned prospect which was located, as it was, between two major faults, the Osburn and the White Ledge, where no commercial ore body had ever been found and where geologists were, for once, in agreement that no commercial ore body would ever be found.

But we did that and spent time and money (mostly time and borrowed equipment) to bring it into comparatively big production—something that perhaps is unusual. We are proud of the fact that we did that without the levy of a single assessment.

Thanks to the MINING WORLD the Lucky Friday Silver-Lead Mines Company has been widely and favorably publicized. We have appreciated the very fine things you have said about us. We are no longer in the Lucky Friday management but we are sure the company will be in good hands and that the Lucky Friday mine will go on to prove further that ore is sometimes where it can't be.

We appreciate the honor which you have paid us and we are happy to accept your award.

CHAS. E. HORNING,
Former president
JOHN A. FEATHERSTONE,
Former manager
LUCKY FRIDAY SILVER-LEAD
MINES COMPANY

Made Staff Read WORLD MINING

Dear Sir:

The newest information of the world mining industry and every modern mining machine advertised in your magazine have been of great interest to us.

As we have so few data concerning mining or modern mining machinery, I have made my staff read WORLD MINING. I am sure that is has helped them to modernize and mechanize all the mines in our country.

KANG YE YONG
Senior Engineer
Mining Bureau
Ministry of Commerce & Industry
Seoul, Korea

English Interested In Rubber

Dear Sir:

It has been called to our attention that the January 1958 issue of MINING WORLD carried an article on rubber chutes at the Kiruna mine in Sweden. Our associates in England are interested in obtaining further information on this item. Along these lines, we should much appreciate your forwarding a tear sheet so that we may write to the principals involved.

S. RALPH DUBROWIN
Natural Rubber Bureau
Washington 6, D. C.

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...*including economy!*

You don't sacrifice economy for big production when you step up to a Cat D9 Tractor. When you see big loads of pay dirt rolling in front of a D9—those can be the most economical yards in strip mining today!

Arrington Mining Co. has found this out at its open pit iron ore mine at Troy, Alabama. Its D9 with No. 9S Bulldozer economically strips overburden that is up to 25 feet thick.

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Many features contribute to the outstanding economy and resale value of the big D9. To name a few: dependable Cat Diesel Engine with new dry-type air cleaners, the exclusive Caterpillar oil clutch, strong main frame and final drives, long-lived, extra-rugged undercarriage, including lifetime lubricated rollers and idlers.

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Caterpillar Tractor Co., San Francisco, Calif.; Peoria, Ill., U.S.A.

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THE D9...
BIG IN PRODUCTION,
BIG IN ECONOMY

Mining World

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MILLER FREEMAN PUBLICATIONS

Drifts and Crosscuts

Congratulations To Safford Prospectors

The sale of 120 mining claims north of Safford, Arizona to Kennecott Copper Corporation for almost $4,000,000 is the most important mining story of the month. The fact that the world's largest copper producer is paying that much cash is important, but what about the prospectors that sold the claims.

The prospectors are the most important part of the story for the mining industry. Their foresight in staking the claims, their determination to hold on to the claims despite adverse reports and hard times, and their faith for many many years are the ingredients that make the mining industry. Take a typical prospector—Albert Spalding who came to the Lone Star Consolidated Copper Company as a boy in the late 1890's. The mine closed in 1907, the original company went out of existence in 1921, but Al Spalding had faith in the Lone Star. In 1926 he was able to get title to one of the Lone Star claims. Soon he and his partners had 34 claims and they formed the Lone Star Mines, Inc. in 1942. The company held on to the claims, did assessment work, and never lost faith. Now Al Spalding's share of the sale is $252,000. Spalding's associates share in the sale, too.

Other prospectors and miners staked their claims around the Lone Star and they sold their claims, too.

To one man, Al Spalding, congratulations for making this mining story possible.

Max Holsinger Now Vice President International Operations

MINING WORLD's general manager, Max F. Holsinger, has been appointed vice president for International Operations of Miller Freeman Publications. This appointment follows his return to San Francisco, California headquarters after nearly two years in Europe where he spearheaded the company's overseas expansion and development program.

During his time abroad, Mr. Holsinger traveled over 60,000 miles throughout Europe, making an intensive survey of the fields served by Miller Freeman journals. Most of his time was spent in the mining, industrial, technical and foreign trade centers of the United Kingdom, West Germany, Scandinavia, France, the Benelux countries, and Italy. His study of these areas was the basis for the opening of two Miller Freeman Publications Offices in West Germany and London in 1958, and will serve as a guide to future expansion in reporting on the international mining industry.

Looking for a modern 2½ yd. shovel?

CHECK THESE MODERN FEATURES

- ✔ Disc type clutches
- ✔ Forced air cooling
- ✔ Multi-Stage Torque Converter
- ✔ Exclusive Powerflo slide pinion
- ✔ Simplicity of design . . . only 14 gears and pinions
- ✔ Simple jack adjustment of crawler treads
- ✔ Dependable air or manual controls
- ✔ Self-removing counterweight
- ✔ Convertible to crane, dragline and trench hoe

SEE THE NEW MANITOWOC MODEL 3100

1st IN PERFORMANCE

1st IN OUTPUT

Here is a new Manitowoc shovel in the 2½ yd. range that will outproduce and outperform anything in its class. Completely modern in design, the Model 3100 provides many exclusive, advanced features that contribute to more yardage per shift at lower net cost per yard.

Though it's a big machine, with all the big machine design and construction features, the Model 3100 handles, travels and can be moved from job to job with small machine ease. It's easy to make fast, short moves by truck because a minimum number of rugged, precisely machined fittings allow you to remove the counterweight, *complete* crawler assemblies and other components without time consuming advance preparation and effort . . . *and* the 3100's overall maximum outside width of only 11'1" (within ordinary RR shipping clearances) means you can run it aboard a standard flat car, as is, and you're ready to go!

The Manitowoc 3100 is a big producer and big earner on any job—shovel, crane, back hoe, clam or dragline. Ask your Manitowoc distributor for additional details and specifications on the new Manitowoc Model 3100 . . . a really modern 2½ yard excavator.

Manitowoc

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(A subsidiary of The Manitowoc Company, Inc.)

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MINING WORLD NEWSLETTER

June 1959

NUCLEAR FRAGMENTATION-IN PLACE LEACHING, . . . is the only method for profitably mining a 50,000,000-ton copper deposit assaying 0.50% with a copper price of 30¢ per pound, reports Colorado School of Mines Research Foundation at AEC's Second Plowshare Symposium. A 40% copper recovery in such a deposit is estimated to cost $0.234 per pound.

A PILOT PLANT FOR THE LABRADOR TROUGH . . . Henry J. Kaiser (Canada) Ltd. has received the design-construction contract for an iron ore concentration plant for Wabush Iron Co. at Wabush Lake.

NEW URANIUM MINING METHOD . . . due for an early trial on Colorado Plateau. The underground, underwater, high-pressure hydraulicking system uses a rotating gaint lowered into an ore-bearing horizon through vertical steel caissons in drill holes. Disintegrated ore will be air jetted to surface. Hole spacing will be field determined; initially, a 50-foot-diameter mining are will be set.

ZIRCONIUM MORE ECONOMICAL THAN STAINLESS STEEL . . . in nuclear reactor field, says vice president of Mallory-Sharon Metals Corp. Price steadily coming down as production picks up.

KENNECOTT BUYS SAFFORD COPPER CLAIMS . . . for nearly $4,000,000 cash, despite a purchase option extending to 1961. Kennecott President Cox reports it will take at least two years to develop the area. Safford miners think Kennecott will soon start a major exploration and development program preliminary to bringing the claims into production. General opinion in Arizona is that the firm got its money's worth in buying the claims.

110,000,000 TONS OF INGOT STEEL . . . predicted for '59 by Cleveland-Cliffs Iron Company. Up 25,000,000 tons from 1958, this assures peak iron ore mining.

FOREIGN IRON ORE SOURCES . . . are being expanded by Bethlehem Steel Co. which already operates large mines in Canada, Venezuela, and Chile, and ships ore to its U.S. furnaces. Foreign expansion is slated in Liberia where Bethlehem joins LAMCO in developing Nimba high-grade ore, and in Chile where plans are for participation with Minera Santa Fe in bringing the large El Laco deposit high in the Andes into production.

MONTANA IRON ORE OPERATIONS RESUME . . . after a year's shutdown. Young-Montana Corp. has reopened its mine near Stanford with a contract for 75,000 tons this year, three times as much as 1957.

TELLURIUM PRICE INCREASES WITH DEMAND . . . from $1.65 to $2.00 per pound for powder. A bright potential exists for this by-product element in a new refrigerator with no moving parts, and for increased use in lead alloys and rubber industry. First commercial output started 30 years ago, but only about five U.S. firms produce it today. Peak output was in 1957 with 254,865 pounds.

ANOTHER PORPHYRY COPPER FOR ARIZONA? . . . Following Safford-Morenci successes, the search accelerates for another major prophyry type copper deposit. Latest rush is westward to the old camp of Chloride. A claim staking boom, optioning of properties, and geological surveys cover Ithica Peak. It's an old district only scratched by a few holes and geophysical surveys.

CESIUM FUELED IONIC ENGINES . . . are predicted for 1956 and as a new use for this newest fuel metal. In a cesium engine, metal is vaporized and diffused through porous tungsten plate where atoms are charged with ions. An electric field directs the ions through an orifice to give a rocket-like propulsion force.

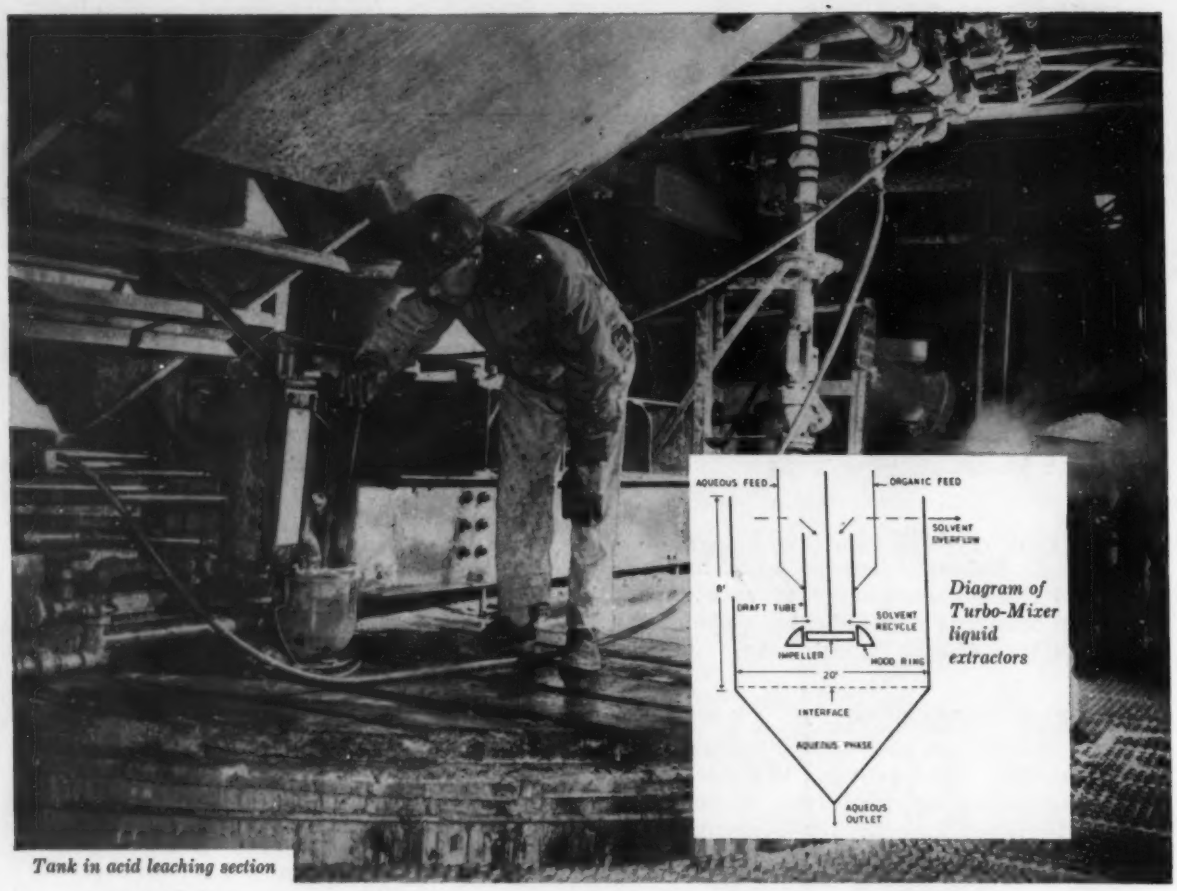

Diagram of Turbo-Mixer liquid extractors

Tank in acid leaching section

VITRO URANIUM HANDLES A WIDE VARIETY OF URANIUM MINERALS WITH TURBO ON THE JOB

When VITRO URANIUM COMPANY of Salt Lake City embarked on a modernization program, they called on GENERAL AMERICAN to assist in the design of the most modern mill possible.

Heart of the plant is the extraction system, and here, GENERAL AMERICAN Turbo-Mixers proved to be key equipment, in both the leaching and liquid extraction sections.

VITRO URANIUM processes a wide variety of uranium minerals which require highly versatile extraction equipment. GENERAL AMERICAN Turbo-Mixers fit this requirement, replacing an outmoded phosphate precipitation operation. Recoveries of uranium fed into the system are "excellent."

As a result of VITRO'S million and a half dollar modernization program, the 660 ton/day mill already has significantly reduced operating costs. Further proof that in processing as in transportation and storage, it pays to plan with GENERAL AMERICAN.

PROGRESS THROUGH BETTER TECHNOLOGY

Blue Ribbon Mining Award

TO: **TURBO-MIXER DIVISION**
GENERAL AMERICAN TRANSPORTATION CORPORATION

FROM: **MINING WORLD/ WORLD MINING**

FOR: Achievement In Equipment Development Aiding the Technological Advancement of the Mining Industry.

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TURBO-MIXER GENERAL AMERICAN TRADE MARK

Capitol Concentrates

Congress Puts Fast Stop to Proposed Copper Sale From DPA-GSA Inventory

The recent flurry in the copper market, caused by the announcement of the Office of Civil and Defense Mobilization that it would start to market 128,000 tons or more of the copper in the DPA-GSA inventory, was halted by the quick and adverse reaction of the Congress.

Letters signed by a large group of Senators, headed by Senator James Murray of Montana, and a group of Congressmen, headed by Representative Stewart Udall of Arizona, protested the action of OCDM and brought forth a statement by the agency that if copper were released at all it would be at the rate of 5,000-tons per month. Senate Resolution 101 demanding that this copper be immediately locked up in the permanent stockpile was promptly passed by a unanimous voice vote. Although the resolution is not binding on the Administration, such an action generally acts as a brake on the agencies.

In any event, OCDM pulled in its horns and sale of the DPA copper at this time is most unlikely. If the metal is not transferred to the permanent stockpile and if it is held in inventory from which it may be sold without Congressional approval, the time to release it would be when there is an acute shortage of copper which might induce the London market to push prices up all out of reason.

Many of the recommendations of the so-called Pettibone report have been adopted by the OCDM. An important one was that all materials surplus to the present stockpile formula be disposed of, although at such rates that the commercial markets would not be disturbed. In some circles it is believed that the proposed action on copper was a trial balloon and that, if it got by without protest, the balance of the DPA-GSA inventory of minerals and metals which might be in salable commercial form would be next on the list. Then the Congress would be asked for permission to dispose of the supplemental stockpile, after which permission would be sought to unload such materials in the national stockpile as are surplus to the present stockpile formula, which reduces the length of a probable war from five to three years.

Such moves, even with the most careful management, could not help but further depress an already ailing domestic mining industry.

• Manganese Aid Is Questionable

An extension of the manganese carlot program, either by Executive order or by Congressional action, would be more advantageous to domestic producers than the incentive payment plan proposed by the Mansfield-Metcalf bill. However, except for a miracle which is not likely to happen, the Office of Civil and Defense Mobilization will not extend the government program beyond the present 28,000,000 unit target, which rapidly is being met. Under the circumstances, unfavorable reports may be expected from interested government agencies.

Therefore, the House of Representatives, even if its Interior Committee should report the bill favorably in the face of government opposition (which seems highly improbable), is not likely to approve the Mills bill, H. R. 1930, which would increase the present program to 90,000,000 long dry ton units. The Mansfield-Metcalf bill (S. 1488) which would pay producers $1.00 per unit bonus for metallurgical grade manganese sold on the open market, would seemingly have the best chance of being enacted as it would not add to the national stockpiles or the GSA inventory and would probably cost the government less than H. R. 1930. It would, however, cause producers severe marketing headaches.

• Even Rumors Affect Metal Markets

These columns, in the past, have carried several items indicating the possibility of managed markets through the authority of certain government agencies to purchase or sell metals and minerals in inventory, or to divert into the open market metals and minerals being received on contract. When markets are "soft" or in close balance, a large volume of sales or purchases is not necessary to alter the trend. This was demonstrated when the Russians broke the aluminum market by dumping a relatively small tonnage in London, and more recently when the mere rumor that the Office of Civil and Defense Mobilization would sell government copper immediately forced the London copper market down by several cents.

• Loopholes In Quota System Create Problem

There is some comment to the effect that Secretary of Interior Seaton may recommend to the President a plan for plugging the holes in the present lead-zinc quota system. Domestic producers are distressed by the fact that finished and semi-finished products were not included in the quota system. This loophole appears to be creating a bad situation and Seaton claims he has it under observation.

• Houses Receives Lead-Zinc Quota Bill

Representative Lee Metcalf of Montana has introduced H. R. 6130, a companion bill to one by Senator James E. Murray and a large group of other Senators, which would apply quotas and a barter program to lead and zinc. These bills were inspired by the Sugar Act, as was the fluorspar bill S. 1285, but in the case of lead and zinc, the quotas are to be applied so as to maintain prices of not less than 15.5 cents per pound for lead and 13.5 cents per pound for zinc. The barter section was written into the bill to placate foreign producers, "to the extent possible." The bill probably would have been more palatable to foreign producers if barter had been made mandatory under certain conditions that might prevail due to the application of quotas.

This bill really should be combined with the Allott bill S. 1538, which would make incentive payments to small lead-zinc producers.

• Senate May Study Assessable Stock Regulation

The Northwest Mining Association for some time has spearheaded a move to block the Securities and Exchange Commission from putting into effect the proposed Rule 136, Rule 140 and Regulation F, which would restrict and control financial operations of assessable stock companies. More recently, several Senators have suggested that a Senate Resolution be introduced directing the Interstate and Foreign Commerce Committees to hold a

hearing on the matter and instructing the SEC to take no action until the committee holds hearings and reports.

This plan would provide a sounding board for those who are interested, would automatically give a time extension, and would determine whether or not the SEC really is stretching the definition of certain words in the Securities Act. If it is judged by the committee that the cause is good, but the SEC is exceeding its authority under the Act, the Act could be amended. If it is considered that the cause is good and SEC is not redefining words in the Act, SEC could be directed to proceed in its usual manner. If it is determined that the cause is bad, the Act could be amended to prevent the SEC from taking the proposed action to restrict the power to levy assessments and sell the stock of delinquents.

• Arbitrary Classifications Should Be Prevented

Representative Berry has introduced H. R. 6235, a bill to direct the Secretary of the Interior to make a preliminary investigation of lands in the United States situated within the exterior boundaries of Indian reservations to determine whether mineral resources exist on such lands in amounts sufficient to justify commercial development.

Aside from the fact that it would be interesting to know the background reasons for introducing such a bill, there would be obvious difficulties in making such a survey. In these days when oil and minerals are found beneath lands which show little or no surface indications, the department, to make a fair and proper determination, would have to do careful and expensive geophysical work on the areas involved. There recently was a case in which a large area of land in a mineral state was declared nonmineral in character by the Bureau of Land Management on the basis of aerial photographs taken by the USGS, completely ignoring the fact that valid unpatented claims existed on the lands. A physical survey would have revealed mine workings. Certainly such casual methods of determining the character of public lands is to be deplored. The Berry bill, if of any use at all, should be rewritten to prevent arbitrary classifications.

• Funds Asked For Ferromanganese Plant

A bill has been proposed to authorize the expenditure of up to $1,000,000 for "demonstration" plants for the production of ferromanganese from "steel mill" slags. Some years ago the government spent vast sums of money on the ill-fated Mangaslag process. The idea of recovering this manganese is most intriguing. At one time it was claimed that about half the domestic consumers' requirements could be furnished from this source as recovered by the Mangaslag process. The bill also would permit some of the money to be used to experiment with making ferro from low-grade ores.

• Fluorspar Quota Bill Faces Difficulties

It appears that the fluorspar quota bill (S. 1285) for all practical purposes may be a dead duck. This bill and the companion House bills were channeled by their sponsors to the respective Interior committees where they might receive sympathetic attention, as these committees are composed mostly of Senators and Congressmen from the West. The Senate already has held hearings on S. 1285 and may make a report to the Senate, which is sure to be favorable.

With a very few notable exceptions, import quota bills are traditionally referred to the Senate Finance Committee and the House Ways and Means Committee. Both of these committees are inordinately jealous of their prerogatives and have objected to the Interior committees handling these fluorspar import quota bills. They have called for them to be discharged and rereferred to Finance and Ways and Means.

The Senate Finance Committee notoriously is the port of missing bills, having large and capacious pigeonholes as a built-in feature. The House Ways and Means Committee generally is not in favor of new import quotas or increased tariffs and is adept at brushing off such proposals. So, all-in-all, the prospects of the bills being acted upon favorably are dark indeed.

The fluorspar bill was to have been the bell-wether for the lead-zinc import quota bills, and perhaps others yet to be introduced. If it fails to get approval, the Sugar act import-quota formula, as applied to minerals, can be kissed goodbye.

• Inventory And Stockpile Sales Considered

There are rumors that the government would like to dispose of most of the metals and minerals presently in GSA and DPA inventories, and also would like to follow the recommendations of the Pettibone report and sell those portions of materials in the national stockpile which, under the new formula, are considered excess to present needs. The comment also is being made that a principal reason for disposing of these materials is to raise money with which to help balance the budget.

• Alaskan Offers Gold Subsidy Bill

The new Representative from Alaska, Ralph J. Rivers, has introduced as H. R. 6195, that portion of the Murray bill (S. 590) which calls for paying a subsidy of $35 per fine ounce to domestic miners for newly mined gold. Placer operations in Alaska have been closing down gradually and should these bills be passed it would not only stimulate placer mining but gold mining also. As the economy of Alaska as a state is mostly in the red ink column, a revival of gold mining would be of the greatest importance.

• Murray Renews Request For Gold Study

Senator James E. Murray of Montana has again introduced his bill to set up a commission to make a full and complete study and investigation of the gold-mining industry in the United States. This commission would be instructed to report to the Senate and House not later than December 31, 1959, the results of its study and investigation together with its recommendations as to legislation necessary to reestablish as an integral part of the domestic economy the production of gold in the United States. The time element is obviously too short and no doubt the bill, S. Con. Res. 27, will be amended to give the commission adequate time in which to do the job.

It is interesting to note that the bill was referred to the Senate Interior Committee where there is some chance of action. The last bill of this kind was referred to another committee which refused to report it to the Senate.

COMING CONVENTIONS

June 8, and 9. Course on INDUSTRIAL WATER CONSERVATION, the University of Michigan School of Public Health, Ann Arbor, Michigan.

July 5, 6, and 7. The 56th anniversary convention of the IDAHO MINING ASSOCIATION, Sun Valley, Idaho.

July 15 to 17. INTERNATIONAL SYMPOSIUM ON SHAFT SINKING AND TUNNELLING sponsored by the Institution of Mining Engineers, Olympia London, England.

August 17 through 28. Fourth annual course in MODERN INDUSTRIAL SPECTROSCOPY, Arizona State University, Tempe, Arizona.

September 14 through 17. Annual convention WESTERN DIVISION AMERICAN MINING CONGRESS, Brown Palace Hotel, Denver, Colorado.

October 4 through 10. The 26th INTERNATIONAL FOUNDRY CONGRESS, sponsored by the Instituto Del Hierro y Del Acero and the Higher Council for Scientific Research Spain, Madrid, Spain.

October 7, 8, 9. Sixth NATIONAL SYMPOSIUM ON VACUUM TECHNOLOGY, sponsored by the American Vacuum Society, Sheraton Hotel, Philadelphia, Pennsylvania.

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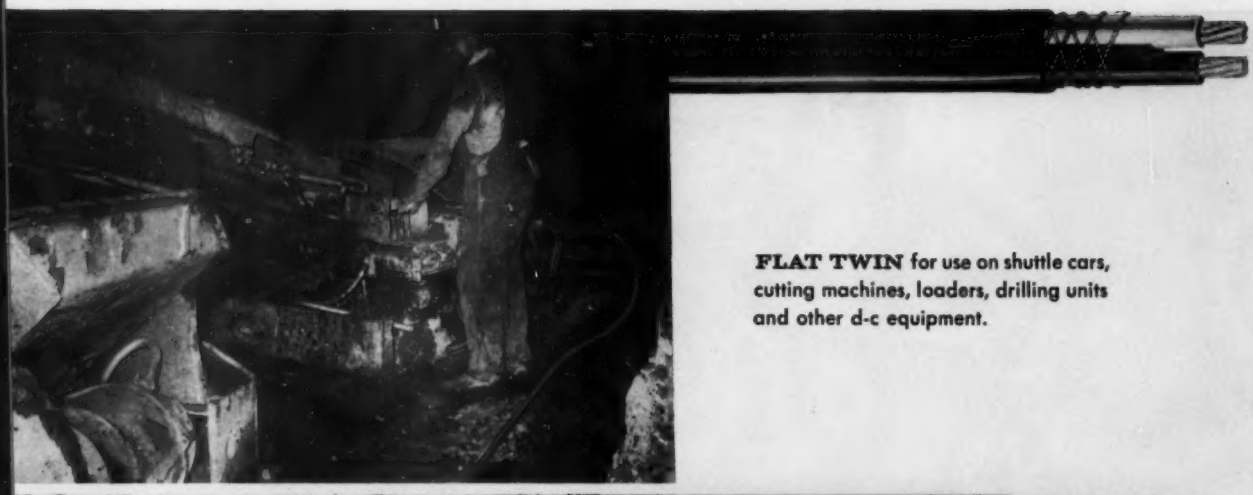

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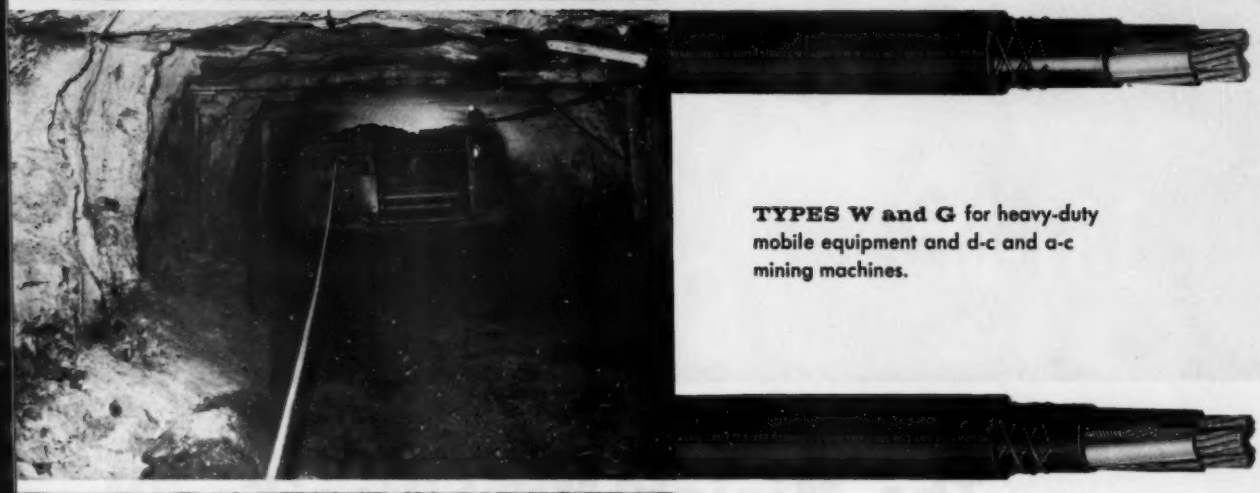

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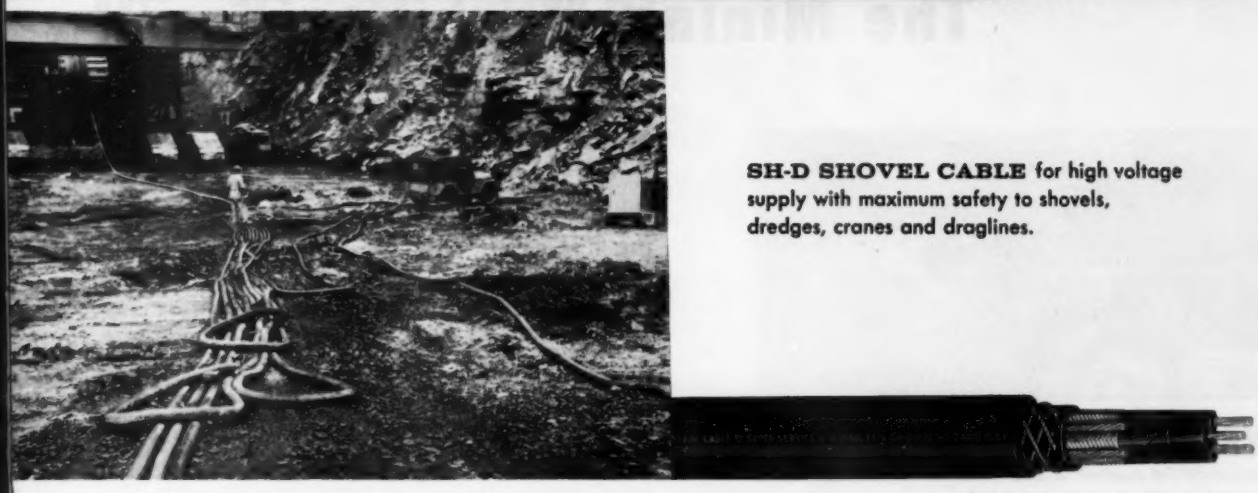

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The Marion 4161 and Marion 151-M cut open pit mining costs so consistently that they became the standard machines for the industry. That history will be repeated on a bigger scale as the Marion 181-M and Marion 191-M come into their own in the copper and iron pits in the decade ahead.

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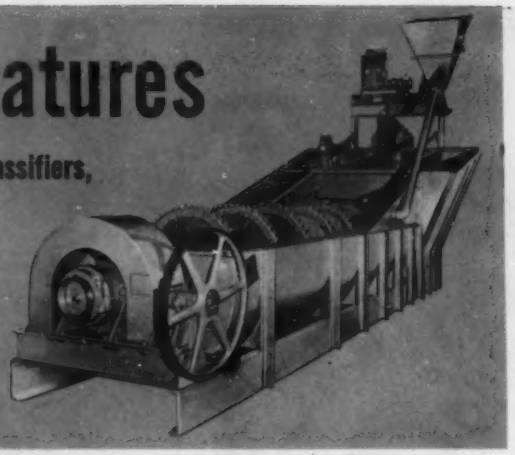
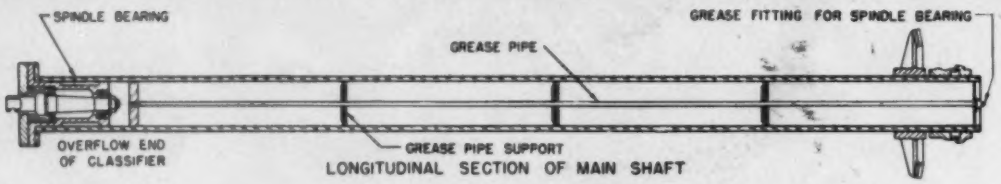
which assure low-cost, trouble-free operation of classifiers, heavy media separators and densifiers

50 years of experience in the design, manufacture, and operating performance of spiral classifiers, heavy media separators and densifiers, has proven the importance of the exclusive mechanical features of the Akins machines... importance in terms of metallurgy, and in the economy of long, trouble-free operating life with minimum maintenance.





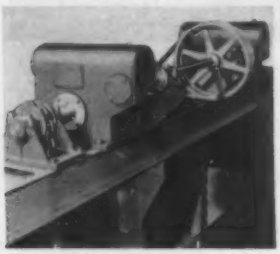
LONGITUDINAL SECTION OF MAIN SHAFT

SUBMERGED BEARING

The patented submerged bearing has proven its advantages of durability, trouble-free operation, and ease of maintenance.

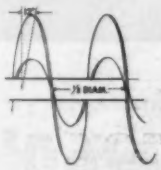
LUBRICATION

The submerged bearing is grease-gun lubricated through a pipe in the main shaft; thus the pipe is isolated from tank contents and protected against breakage. Grease fitting is at upper end of shaft for maximum convenience.



MECHANICAL LIFTING MECHANISM

The lifting device consists of chains, chain sprocket sheaves, and motor-driven or hand-operated reducer unit. Experience has proven this mechanical arrangement to be the most positive, with no possibility of slippage. Minimum maintenance. No packing glands or rods to become worn.



SPIRAL PITCH

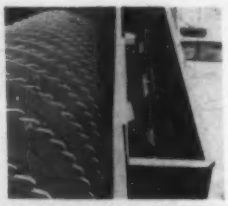
50 years of experience has shown that the half-diameter pitch gives maximum raking capacity and results in less slippage and less wear than advanced pitch spirals.

TANK SUPPORTS

Web beam substructure supports tank. There's no load to be carried by tank. This also reduces installation cost by eliminating need for extra sub-structures to support tank.

WEARING SHOES

Wearing shoes are made of various alloys, including Climax 42-A. Patented serrated wearing shoes are available for special applications. Special inner shoes are provided for heavy rake loads.

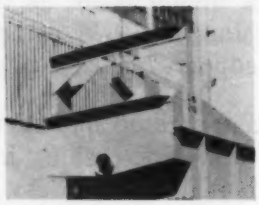


DRIVE

The bevel gear, V-belt drive has proven to be the most trouble-free and flexible. It permits mounting the motor, or motor-reducer, horizontally; and changing speeds quickly and inexpensively, by simply changing V-belt sheave ratio.

OVERFLOW BOX

An overflow box, with a pipe connection, is furnished as standard... requires only a single connection.



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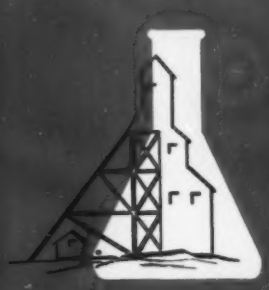

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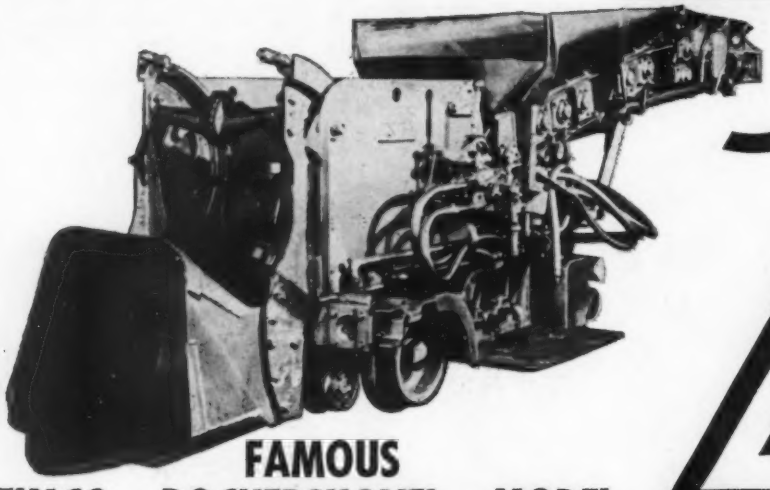

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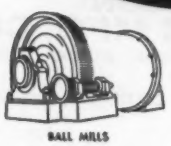

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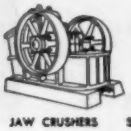

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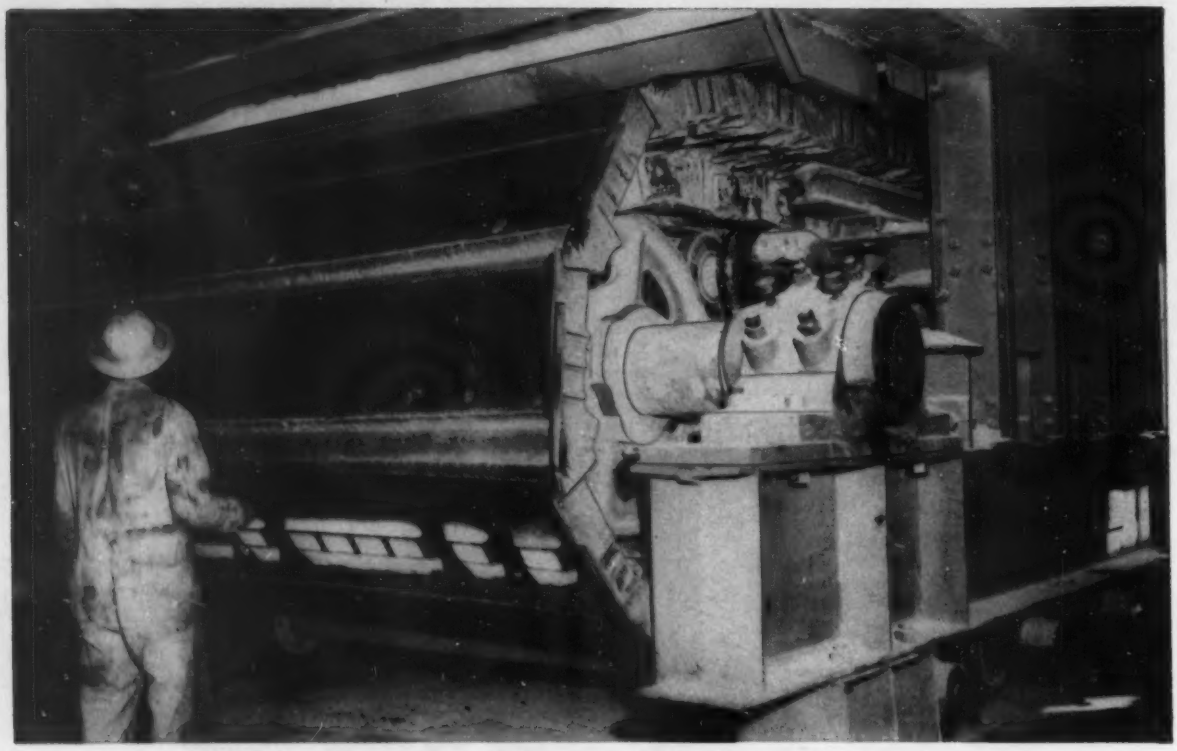

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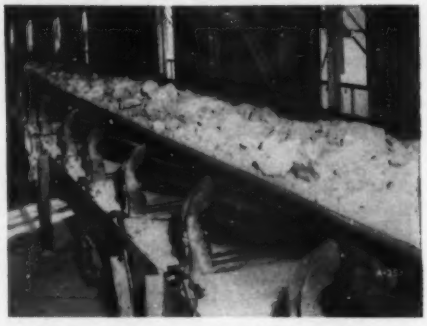

A "48" wide primary belt carries a heavy load of 10 inch copper ore to processing at a Southwestern Copper mining installation. STEPHENS-ADAMSON engineered conveyor systems are designed to handle big tonnage dependably and at the lowest operating cost per ton of material handled.

WRITE FOR BULLETIN 255

S-A

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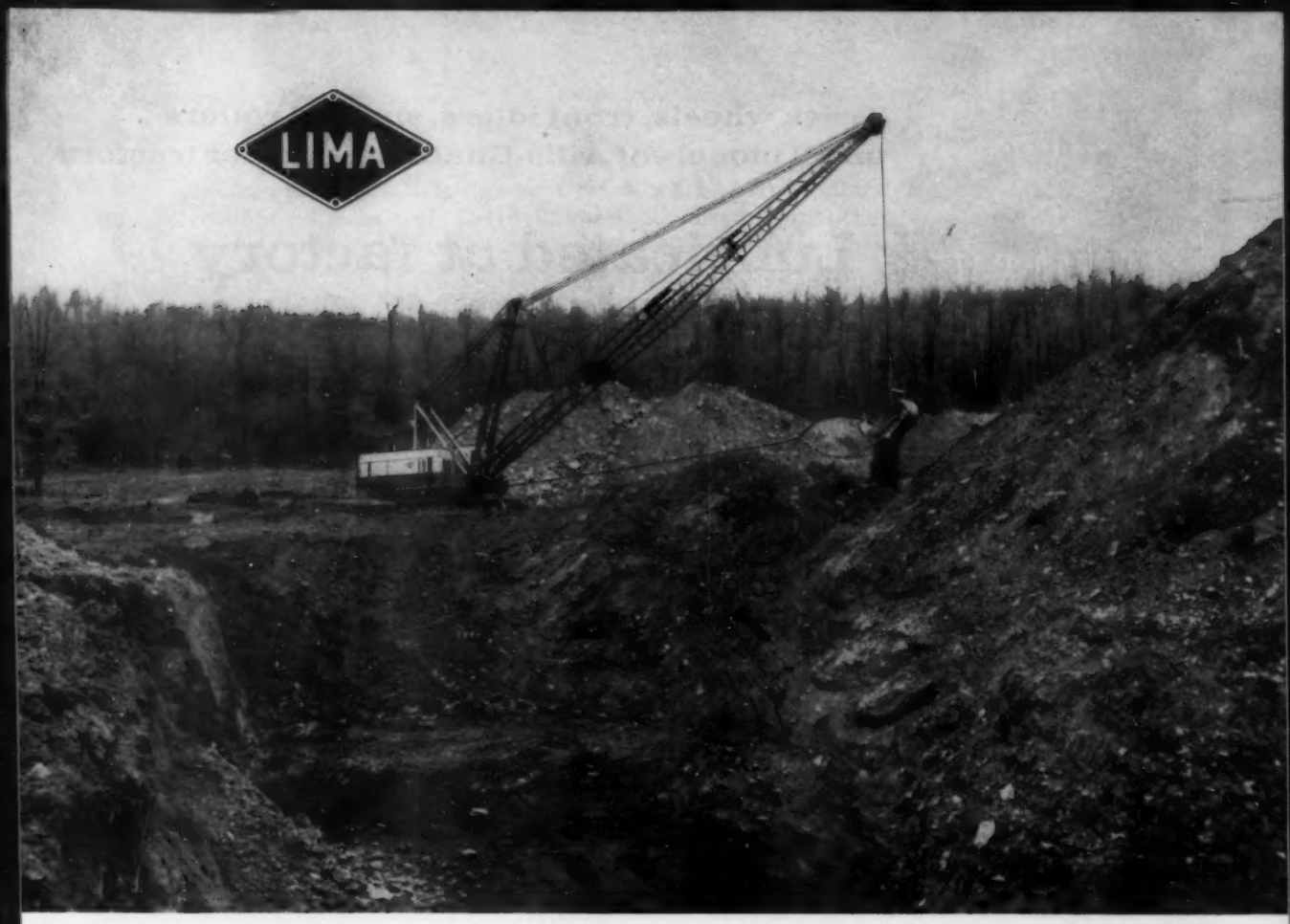

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Giant Lima 2400 delivers brute force for profitable high-output stripping

"It really pays to buy a Lima!" That's what Edward G. Kriebel, C & K Coal Co. partner, says about the firm's Lima 2400 Dragline. "We handle more yardage per shift with the Lima than we could with any competitive machine I know of," he tells us.

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"Lima gives you more machine per dollar than competitive makes. Its extra quality is clear to anyone who knows heavy equipment. Component parts are heavier and better made. Maintenance is low, distributor and factory service excellent.

"It's fast, smooth and easy to operate. Extra long, wide crawler tracks give the 2400 a rock-solid base on any surface, yet permit it to propel itself anywhere on the stripping site. It's a money-making machine!"

Interchangeable front end attachments make the Lima 2400 one of the most versatile heavy-duty rigs you can buy today! It can be converted in the field from variable capacity dragline to 6-cu. yd. shovel or 110-ton crane.

Quality Built Throughout

Anti-friction bearings throughout simplify lubrication, reduce wear. Big, wide air operated clutches respond instantly, lessen operator fatigue. Torque converter reduces shock loading, prevents engine stall, gives cables longer life, helps lower maintenance cost. Gears are spline fitted to shafts . . . all shafting is heat-treated alloy steel. All wearing parts are induction hardened for long life.

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Wheel

Truck wheels, front idlers, support rollers on all models of Allis-Chalmers crawler tractors

Lubricated at factory need no further greasing

Every Allis-Chalmers crawler tractor—whether produced today or any time during the past 17 years—offers its owner the twin secrets of permanent lubrication.

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Allis-Chalmers tapered roller bearing wheels roll much more freely than ordinary bushing types . . . reduce power-robbing friction . . . give you more of your engine's horsepower at the drawbar or moldboard where it pays off in production. The tapered roller bearings maintain precise alignment of all parts . . . protect the perfect seal by minimizing side thrust and wobble . . . eliminate the uneven wear that makes positive sealing of bushing-type assemblies impractical.

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The "Positive Seal" that makes permanent lubrication possible is effected by two steel sealing rings working in combination with the tapered roller bearings. These two rings, smoother than glass, are held firmly together by strong steel coil springs. One seal remains stationary; the other turns with the truck wheel. These seals are micro-finished to near perfect flatness. Their surfaces fit together so precisely that nothing can get through . . . a perfect seal.

HD-6
66.5 net engine hp
12,640-lb drawbar pull
12,850 lb (as shown)

HD-11
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20,470-lb drawbar pull
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Safe, permanent lubrication of truck wheels, front idlers and support rollers requires seals that will keep all moisture and other foreign materials out . . . the lubricant in. Only Allis-Chalmers offers seals which are positive because of their use in combination with tapered roller bearings. The Allis-Chalmers Positive Seal, tapered roller bearing design has been proved in the field through more than 20 years . . . through millions upon millions of operating hours. When introduced in 1938, this outstanding design replaced bushing-type assemblies similar to those used today in other tractors. Allis-Chalmers abandoned bushing-type truck wheels because, in its opinion, they could not be positively sealed.

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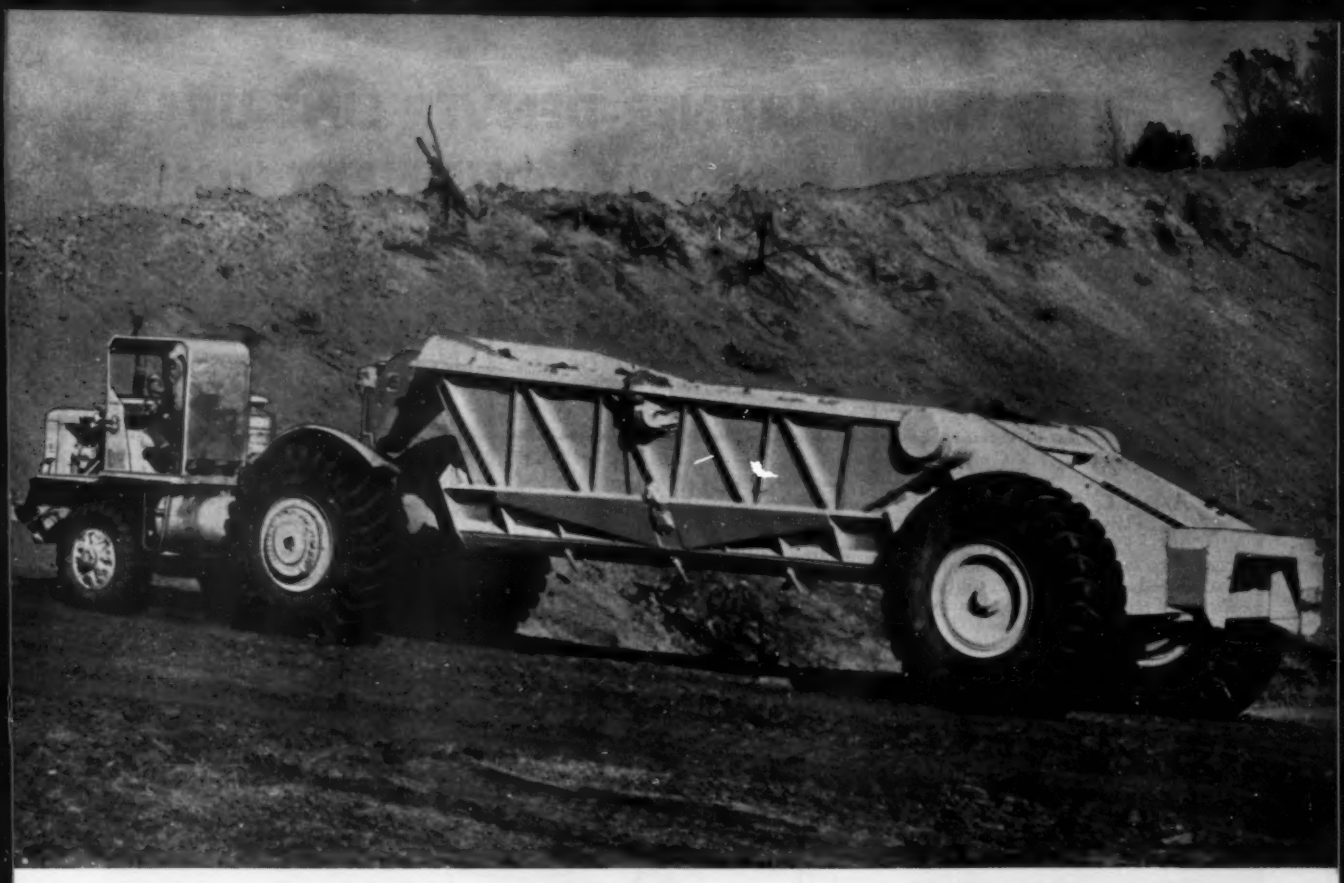
CAN OUT-EARN ANY OTHER BIG

In the new 27 cu. yd. 495 Paywagon®, big earning advantages start with the new International DT-817 diesel engine. Forty-ton payloads highball upgrade or over rough and soft spots faster than ever behind the locomotive-like wallop of 375 turbocharged hp—more power per struck yard than any comparable wagon! Next, the "495" Paywagon's exclusive power-opened clamshell doors give positive dumping control—and retract parallel with hopper sides—"clean as a whistle" from wiper plate action! Pull-away clearance, to straddle 60"-high windrows, eliminates dumping delay! Too, the 495 Paywagon has new full 90° turning in either direction; new road-hugging design to gain top mph safely, out and back, at speeds up to 32.0 mph. Plus exclusive extra operator comfort and control features that reward you with extra production!

In the new 24 cu. yd. 495 Payscraper,® exclusive International DT-817 diesel power earning advantages team up with new cutting width and tapered bowl design—to heap-load faster than any other 3-axle scraper of its size. And it hauls at speeds up to 32.0 mph! The scraper's big 131" cutting width promotes fast dirt break-away, permits both unit and pusher to operate within the cut for best traction. Exclusive tapered bowl design boils dirt toward center, reducing side spillage; permitting positive, forced ejection even of sticky or frozen materials. More hp per struck yard than any competitive unit—wheel and bowl leveling adjustment —custom-designed cable control unit—full 90° turns—all team up to make the 495 Payscraper the top producer of its size class!

In the new 24 cu. yd. 295 Payscraper—you get the same big-capacity, high-torque engine that powers the 495's: the 375 hp DT-817! You get haul speeds up to 29.1 mph—matched with new automotive comfort and control features, that include a 16-adjustment seat. And the scraper unit of the 2-axle 295 is the same heap-loading, tapered bowl, wide-cut scraper featured in the 495 Payscraper!

Match any new International Earthmover against any similar equipment on your job or in your mind—for capacity, operating ease, low costs and net profit earning ability. See your International Construction Equipment Distributor!

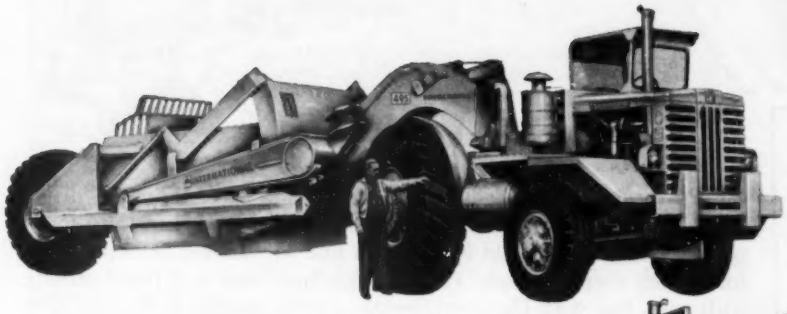


Heaped, the new 375 hp International Paywagon highballs 40.5 cu. yd. (or 40.5 tons) as fast as 32.0 mph. Choose either 4-speed Power Shift or 9-speed constant mesh transmission drive.

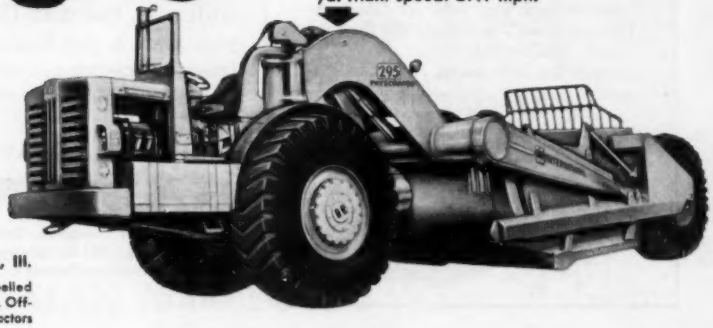
Earthmover

WHEEL RIG ON YOUR JOB!

Controlled with new custom-designed cable control unit, the 375 hp International 495 Payscraper speeds 34 cu. yd. heaped loads up to 32.0 mph. Its apron can "gape" open as high as 98"—for sure ejection of all materials!



Positive-acting air brakes—16-adjustment spring hydraulic seat—unobstructed vision—flush-deck safety—power steering—all add up to production-boosting operator comfort and ease of control of the new 375 hp 295 Payscraper. Heaped capacity: 34 cu. yd. Max. speed: 29.1 mph.



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2 BOOMS . . . hydraulic, creep-free booms—straight, offset or tripod types. A choice of hand or automatic hydraulic pump. Lengths to suit your drilling needs.

3 DRIFTERS . . . seven hard-hitting, fast-acting models—the most complete line of time-tested drifter drills available. Sizes from 2¾" to 5½" cylinder bore.

4 DRILL POSITIONER . . . DPU hydraulic drill positioner—120° swing (60° from center to center), 90° dump (30° up, 60° down)—can be indexed for roof pinning or down hole drilling.

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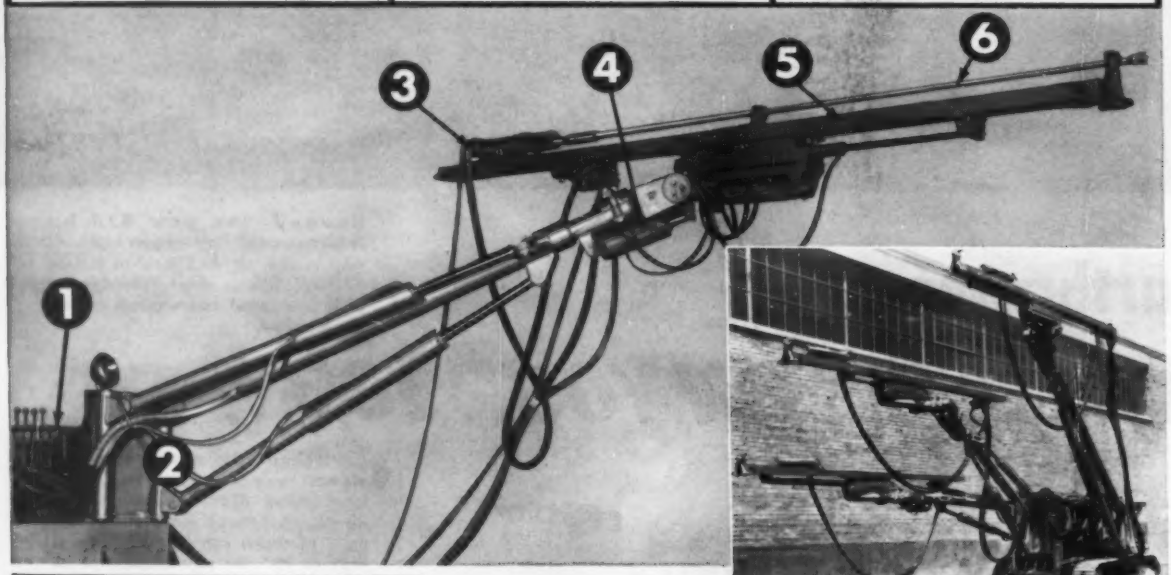
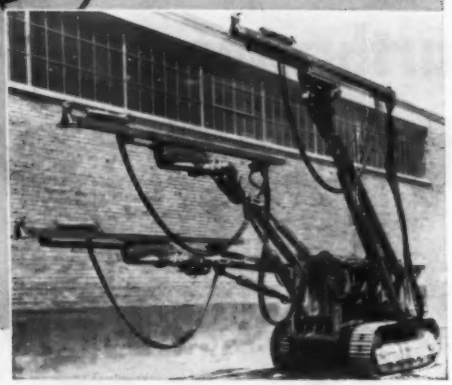
6 DRILL STEEL . . . most complete line of sectional carburized drill steel (five series from ⅞" hex. to 1⅞" hex.) in lengths from 2' to 20'. Carburized to resist abrasion longer and increase compressive strength. Also carburized made-up steel in a variety of sizes, shanks and lengths.





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Gardner-Denver men and mining engineers have worked hand in hand for many years. This teamwork has resulted in a safe, hard-hitting line of drilling equipment for use in every type of rock and ore. At Gardner-Denver there's no substitute for men—our philosophy of growth for 100 years.

Here's the most complete and versatile line of coordinated drills, feeds, booms and controls available anywhere. Save time and manpower. Drill faster. Hold line cuts in line. Or use big bore burn cut for pulling deeper rounds. Handle high-face room and pillar mining with ease. See your Gardner-Denver jumbo specialist. He can help you plan a job-built, custom-engineered jumbo using your own truck or tractor . . . or deliver a complete Gardner-Denver crawler-, wheel- or rail-mounted jumbo.

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Mining World

THE IMPORTANT MINING MAGAZINE EVERYWHERE

June 1959

INTERNATIONAL PANORAMA

BUTTE, MONTANA—The Anaconda Company has reopened the Stewart mine for production of deep-level vein-copper ores.

JOHANNESBURG, UNION OF SOUTH AFRICA—A new company has been set up to recover manganese, used in dioxide form as an oxidizer in uranium mills, from tailing at West Rand Consolidated Mines Ltd.'s uranium mill. Manganese will be recovered electrolytically; hence, the new company—Electrolytic Metal Corporation (Pty.) Ltd.

HOUGHTON, MICHIGAN—Bear Creek Mining Company (Kennecott Copper Corporation) and the Michigan Conservation Department are discussing an exclusive all-minerals lease to Bear Creek covering 130,000 acres in the Ottawa National Forest.

THOMPSON, CANADA—International Nickel Company of Canada, Limited is installing an electrolytic refinery for direct reduction of nickel matte at its new Thompson nickel mine.

LA PAZ, BOLIVIA—The Japanese mining firm, Nitosh Mining Corporation, has taken an option on the Chacarille copper deposits near the Coro Coro mine on the Bolivian-Chilean border.

MOAB, UTAH—Utah led in the production of uranium concentrate in 1958 with production of 7,798,087 pounds valued at $67,472,991. Total USA production of 24,837,325 pounds was valued at $233,045,449.

COPPERHILL, TENNESSEE—Tennessee Copper Company has completed its new Calloway B shaft and is hoisting ore through it.

LAKEVIEW, OREGON—Lakeview Mining Company is converting its underground uranium mine to open pitting because of heavy ground problems. Isbell Construction Company has stripping contract.

SAFFORD, ARIZONA—Kennecott Copper Corporation has exercised its option to pay $4,000,000 in cash for 125 copper claims north of here. A major porphyry type copper ore body apparently has been indicated by deep diamond drilling.

SANTIAGO, CHILE—Andes Copper Mining Company has started mining of copper ore at its new El Salvador mine. A new flotation mill was built to treat the 1.75 percent copper ore.

PITTSBURGH, PENNSYLVANIA—Steel production reached an all-time high in the United States in March at 11,567,000 ingot tons.

LANDER, WYOMING—Vitro Minerals Corporation has contracted to mine 100,000 tons of uranium ore per year for sale to and for milling by the Susquehanna Corporation, owner of Fremont Minerals, Inc., which operates the uranium mill.

SALISBURY, SOUTHERN RHODESIA—Encouraging results of preliminary copper prospecting by Rand Mines Ltd. in the Kario district have been reported. Rand Mines has applied for an exclusive prospecting grant over 500 square miles.

GRAND JUNCTION, COLORADO—The United States Atomic Energy Commission has extended and increased the size of its uranium purchase contract with Lucky Mc Uranium Corporation. Lucky Mc will enlarge its Gas Hills, Wyoming mill to 980 tons per day for operation through December 31, 1966.

ANTOFAGASTA, CHILE—Bethlehem Steel Corporation is considering development of the large high-grade El Laco iron ore deposit of Compania Minera Santa Fe.

RIDDLE, OREGON—A new monthly production record was set by Hanna Nickel Smelting Company in April when output was over 2,000,000 pounds of nickel.

JOHANNESBURG, UNION OF SOUTH AFRICA—The South African uranium miners have offered to sell up to 1,000 tons of uranium oxide per year to the International Atomic Energy Agency at a base price of $8.00 per pound.

Japanese Firm Buys Iron Mine in Chile

The newly formed Japanese firm, Atacama Mining Company, has bought the Las Andrianitas iron mine near Copiapo, Chile. The company, recently formed by Mitsubishi Shoji Kaisha and the Mitsubishi Mining Company (see MINING WORLD, January 1959, page 73), will build a road from Copiapo City to the mine and another road from the mine some 70 kilometers to a floating pier for loading ore at the port of Calderille.

Operations are scheduled to begin in July. A Mitsubishi ship has brought machinery for the mine from Japan, and two 40,000-ton ships costing a total of $12,000,000 are under construction in Japanese shipyards for ore transportation. Shipments are expected to reach 1,000,000 tons annually, with 1960 shipments estimated at 325,000 tons.

The purchase of Las Andrianitas results from three years of investigation and planning on the part of the Mitsubishi firms and a Chilean partner who owns three mines in the Copiapo region. Surveys made by the joint Japanese-Chile venture indicate that there are about 20,000,000 tons of iron ore in that area.

J. R. Simplot Takes Over Anaconda Phosphate Mine

Under a long-term contract, the J. R. Simplot Company's fertilizer and mining division has assumed full management and control of the Anaconda Company's open-pit phosphate mine at Conda, Idaho.

Simplot expects to double the Conda operation, increasing output to 300,000 tons, according to W. Grant Kilbourne, vice president and general manager. "We will do all of our own mining and will use our own equipment made up of new units, as well as equipment transferred from other operations," he said.

Production from the Conda mine will go to both Anaconda and to the Simplot fertilizer division at Pocatello, Idaho, where a contact, sulphuric acid plant is under construction. The company's Centennial phosphate mine on the Idaho-Montana border has been set aside as a future reserve, with present operations suspended. To maintain tonnage, Simplot is increasing production at its Fort Hall mine.

The Anaconda Company pioneered phosphate rock production in the Utah, Idaho and Wyoming area in the 1920s by opening an underground phosphate mine. This has been converted wholly to an open-pit property.

In July—How Ambrosia Lake U_3O_8 Miners Solve Water Problems

Look for Cesium Minerals in Lithia-Rich Pegmatites For Growing Use in New Thermoelectric Generators

Cesium, uranium, and indium metals are playing the most important part in two new thermoelectrical processes for converting heat directly into electricity. Both are based on variations of the thermocouple where an electric current flows between different metals in contact.

The first is direct conversion of nuclear energy into electricity by use of a plasma thermocouple and was perfected on a laboratory scale by the AEC'S Los Alamos Scientific Laboratory. A rod of metallic uranium surrounded by enriched U-235 is suspended inside a vacuum sealed container holding liquid cesium. The unit is lowered into a reactor where fissioning of the U-235 takes places with release of great heat. At the same time the cesium under vacuum partially gassifies and is ionized by the uranium to form a plasma of electrically charged particles. An electric current is then generated. While the device has operational problems, it has a very high thermoelectric efficiency.

News of the experiment turned prospectors and geologists to their reference books to find out about cesium. They knew there was plenty of uranium. MINING WORLD quickly found out the following about cesium if you want to prospect for it.

Briefly, look for it in pegmatite dikes rich in lithia minerals. The major cesium ore is pollucite ($CsSi_2AlO_6$) which is a colorless mineral often found in cubes and always in pegmatite dikes. It has a hardness of 6.5 and a specific gravity of 2.9. The hand sorted ore usually assays between 25 and 30 percent Cs_2O and is worth about $0.75 to $1.00 per pound when a market exists. South West Africa has been the principal producer in recent years with sporadic production reaching 147,000 pounds in 1956.

A major deposit and the largest in North America, if not in the world, has been developed in the lithium-bearing pegmatite of Montgary Explorations Limited at Bernic Lake, Manitoba, Canada. Diamond drilling has indicated an estimated 150,000 tons of pollucite assaying 25 to 30 percent Cs_2O. The firm's mine has recently been reopened to mine and ship lepidolite, spodume, and amblygonite so a drift is being driven to the separate pollucite ore body to mine test lots. The U. S. Bureau of Mines will receive the first shipment of 100 pounds for metallurgical research and testing.

Cesium minerals are also found in the lithia-rich pegmatite of Bikita Minerals Private Ltd. in Northern Rhodesia; in the Brown Derby mine in Gunnison County, Colorado; and the Harding mine in Taos County, New Mexico. The lepidolite and spodumene in last two contain about 0.09 percent Cs. The Carlsbad, New Mexico potash mines and the Trona Lake, California brines also contain cesium.

American Potash and Chemical Corporation produces a variety of cesium chemicals from lithium byproducts at its San Antonio Chemicals Company mill at San Antonio, Texas. Bikita ore is milled here.

Simultaneously, and independently, Westinghouse Electric Company made a thermoelectric couple with an efficiency of 10 percent by using indium, arsenic, and phosphorus. Indium is a constituent of many zinc ores, but no ore has ever been mined solely for its indium content. The Anaconda Company and American Smelting and Refining Company are largest producers from their zinc smelting and refining.

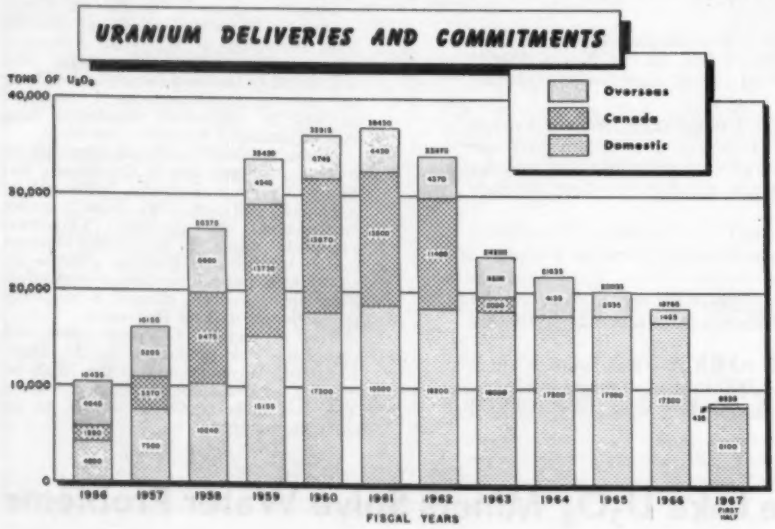
Uranium Miners Assured Big Market Through 1966 By Jesse Johnson, AEC's Raw Materials Director

The United States Atomic Energy Commission is making a switch from foreign uranium purchases to domestic purchases as rapidly as contractural obligations permit, reported Jesse C. Johnson, director, Division of Raw Materials, at the annual meeting of the Wyoming Mining Association. The AEC plans a remarkably high and surprisingly uniform domestic concentrate production through 1966, Mr. Johnson explained.

Currently, 47 percent of purchases are domestic with the majority of foreign concentrate coming from Canada. After June 30, 1962, 84 percent of purchases will be domestic. Top year for domestic purchases will be 1961 at 18,500 tons. The accompanying bar chart shows purchase details. Note how Canadian purchases will drop off. While the AEC has an option to extend its Canadian contracts through 1966 at $8.00 per pound of U_3O_8 in concentrate, there IS NO COMMITMENT to exercise these options which expire March 31, 1961, Mr. Johnson said. He added, "No new milling project should be considered today unless it can operate successfully at the flat $8.00 per pound price which becomes effective March 31, 1962.

"Domestic uranium producers are fortunate in having an assured market through 1966. By that time the outlook for atomic power and the market for uranium should be much clearer," he added.

For the future, he saw a bright picture for uranium mining because, "The long-range concern is over a possible uranium shortage, not an oversupply."



Build Unique Truck Skip Hoist in Belgian Congo

A new inclined skip hoist to raise fully loaded 16-ton trucks from the Kisenge open-pit manganese mine of the Beceka company is being installed by Ateliers de Constructions Electriques de Charleroi.

Trucks will be loaded with ore in the bottom of the pit, driven onto the skip, hoisted up a 25 percent grade to the pit rim, and then driven off the skip to haul the ore directly to stockpiles ahead of the washing and concentration plant. The empty truck will be returned to the pit bottom by reversing the cycle. The two, 55-ton skips operate in balance on parallel tracks. Initial capacity will be 800 tons per hour which will be cut to 400 when the ultimate 1,050-foot length is reached.

As the loaded truck drives onto the skip, its weight will actuate an automatic wheel locking device to hold the truck firmly in place. Each skip is equipped with eight electromechanical braking shoes which automatically engage in case one of the two hoisting cables breaks. The hoisting cycle is automatic after the operator presses a button to start the hoist.

Philippine Company Finds Rock Phosphate Deposits

Preliminary exploration has revealed rock phosphate deposits in Negros Island and Iloiolo Island, Philippines, according to Simon V. Dumaguing, Jr., field geologist for Ornopia and Associates, Incorporated, of Cebu City. The deposits lie between two limestone formations known as the Carcar limestone and the Talabe formation, both of Tertiary origin. Studies of surface showings prove them to be marine concretion beds and not a product of leaching from guano deposits.

The properties are currently under exploration by test pits and trenches. Computed tonnage, based on geological mapping and sampling of surface showings, indicates approximately 480,000 tons of 31 percent P_2O_5 in Negros Island. Dumaguing believes that diamond drilling will increase reserves. On Iloilo Island, phosphate mineralization has been traced for almost three kilometers, but of undetermined thickness.

Kennecott Plans To Pay Nearly $4,000,000 For 120 Copper Claims North of Safford, Arizona

After three years of deep diamond drilling and geological and geophysical surveying, Kennecott Copper Corporation is buying 120 mining claims northeast of Safford, Arizona. Kennecott's exploration subsidiary —Bear Creek Mining Company—actually did the work.

The Lone Star Mines, Inc's. group of claims were the key to the sale but a large group of unpatented claims on Lone Star Mountain and Webber Peak were also included. Claims were purchased from a group of Safford prospectors, lawyers, and businessmen.

It's been very hard to accurately pin down just what Kennecott has found at Safford. Claim owners refer questions to field geologists who say they aren't authorized to speak for the company. Officials in Salt Lake City, Utah issue very short statements saying nothing and differing greatly with the sale price happily acknowledged by the claim owners.

An engineering guess would be that Kennecott doesn't know exactly what it has. President Cox has termed it a "large copper mineralized area."

MINING WORLD has evaluated all reports and published statements and draws these conclusions from available information.

- Kennecott isn't sure of the total tonnage and grade on these claims.
- The tonnage could be very, very large.
- This large tonnage is very low grade by today's open-pit mining grades.
- The deposit is deep, several holes bottomed over 2,000 feet.
- Metallurgy is complex, oxides (and there are a lot of them) complicate recovery of sulphide minerals.
- Stripping ratio for any open pit will be high.
- Underground mining will be expensive.
- There is a much smaller tonnage of higher grade material in several zones within the mineralized mass.
- Possibilities to increase reserves in depth have not been exhausted.
- Low-cost fresh water necessary for treating several 10's of thousands of daily tons will have to be developed.

Copper was originally discovered at the Lone Star in the late 1890's, and high-grade shipments of ore mine from veins have been made at irregular intervals since the discovery with most of the production prior to 1907. However, Kennecott's interest is in disseminated copper rather than veins.

First interest in this disseminated copper was in the spring of 1949 when Consolidated Coppermines Corporation initiated exploration. An examination by E. N. Pennebaker, then consulting geologist for Coppermines, led to the conclusion that this area presented a major display of rock alteration and metallization and that it might contain large bodies of low-grade ore. Consequently, ground was optioned, additional claims were located, and a program of geologic mapping and drilling was undertaken. About a year later The American Metal Company, Limited joined Coppermines, and the project was thereafter continued as a joint venture.

The first few exploratory holes were collared in mineralized bedrock exposed on the southwest face of the Gila Range. Although they did reveal the presence of secondary chalcocite enrichment, the tenor of the material was low and the oxidized capping was found to be quite thick.

In the meantime, for the purpose of protection, mining claims had been located to the northeast, lapping over the crest of the range where bedrock was covered by barren young volcanic rocks. In the course of blasting out a discovery shaft on one of these claims, the volcanic lava was pierced at a depth of only 5 feet, revealing underlying leached capping of excellent quality in mineralized quartz porphyry breccia.

The program was then re-vitalized, and deep drilling was carried northeasterly to search beneath the volcanic caprock. Disseminated copper mineralization was found to continue into this area beneath a thick cover of oxidized and mineralized bedrock, below the capping of younger, barren volcanics. This mineralization was generally low in tenor, and a substantial thickness contained only oxidized copper minerals above a zone of low-grade and erratic chalcocite enrichment.

Because of the very thick overburden, the low tenor of the copper mineralization found up to that time, and the abundance of oxidized minerals, it was deemed inadvisable to drill more than a few deep holes in the ground then controlled. Consequently the project was discontinued early in 1952 by Coppermines. However, it is reported that Coppermines retained an interest in some claims and this interest is said to have passed to Cerro de Pasco Corporation under its recent purchase of Coppermines so that Cerro appears to be a very minor partner with Kennecott in some claims.

Several years later the Rare Metals Corporation of America entered the district, drilled several holes to the north, all of which found comparable grade mineralization, and terminated its leases because grade was too low. Later Rare Metals turned its records over to Kennecott. Drilling large areas around these two sets of early holes has since been done by Kennecott.

Kennecott's vast program of claim staking, road building, geological and geophysical surveying, and steady diamond drilling by a number of rigs attracted Phelps Dodge Corporation. P-D staked and optioned claims and started its own drilling program on claims just to the north, but joining Kennecott's (see map). P-D is still using several drilling rigs and a well confirmed report indicates one hole found about 1,000 feet of 2.0 percent copper.

Recently American Metal Climax, Inc. entered the district and optioned claims further north on Turtle Mountain in the same area where P-D had previously drilled several holes.

One must remember that much of the surface area between Safford and P-D's large Morenci mine is covered by basalt flows to understand why more exploration has not been done and why the discovery hole in an area where the basalt was eroded is important. There may be some relation to the Morenci mineralization as there appears to be a major regional northeast striking series of shears extending toward Morenci. Several monzonite stocks or plugs pierce the basalt north of Safford. By no means are all of these mineralized but there is peripheral mineralization around some. Surprisingly most of the mineralization is reported in older igneous flow rocks (andesite-rhyolite etc.) than in the monzonite.

Every one wonders what Kennecott will do next. There is no question that something will be done. President Cox reports that it will take two years to finish preliminary work at the property. Sound engineering should see Kennecott do most if not all of the following:

Patent all located claims, continue surface drilling on a large scale to fully delimit and sample the district, pick a suitable mill site, make engineering studies of possible water sources and follow a plan to develop large amounts of water, locate a tailing pond site with provision for reclaiming water, sink a shaft, and develop the ore body through drifts and crosscuts for bulk sampling, geological interpretation, and to mine metallurgical test samples.

If a decision is made to leach in place after fracturing or shattering the mineralized zone by atomic blasting or undercut caving, there would be no need for large mill and tailing pond sites.

In summation, there is lots of copper north of Safford. As much as 5,500,000,000 pounds on Kennecott's claims. Phelps Dodge and Kennecott have found copper by drilling. Additional drilling will find more copper.

Lead-Zinc Output Cuts Set By Free World Producers

A voluntary plan to reduce supplies of lead by 90,000 annual metric tons, and zinc output by 104,000 annual tons has been agreed to by major world producers of these two metals. The plan is a necessary step to bring world production closer to world consumption in an effort to stabilize the industry. The plan was developed by the United Nations Lead and Zinc Committee at its meetings in New York from April 28th through May 6.

The Soviet Union was a member of the Committee and agreed to reduce its exports of both lead and zinc from 10 to 15 percent below the 1958 figures.

This cut back on a world-wide basis was welcomed by United States miners who had already made very substantial cutbacks in an attempt to bring supply and demand in balance. Once the cut backs have become effective there is the possibility that the United States government will be agreeable to reducing or eliminating the current Import Quotas on these two metals.

Planned reduction in commercial exports and sales for zinc are: Australia, 3,500 metric tons; Belgium, 4,500; and the Belgian Congo, 3,000. Estimated 1959 mine production is to be cut 15,000 tons by Canada; 5,000 by Mexico; 2,000 by Peru, and 15,000 by the United States.

Lead output on a mine basis will be cut 13,000 tons by Australia; 21,000 tons by Mexico from 1957 rate; 9,000 tons by Canada below 1958; 15,000 tons below 1957 by West Germany; 15,000 below 1957 by Peru; 15,000 below 1957 by Union of South Africa; and 65,000 tons by United States below 1957 output.

Three New Projects . . . .

Tailor Metallurgy to Ore at Hayden

1. MODIFIED MILL recovers more copper per ton ..... Page 31

2. SPONGE IRON and acid facility makes reagents for mill ... Page 33

3. NEW COPPER SMELTER adds overall flexibility ..... Page 36

In the past four years, Ray Mines Division of Kennecott Copper Corporation has poured nearly $25,000,000 into metallurgical projects at Hayden, Arizona. These projects include: (1) modification of the Hayden mill to provide for a leach-precipitation-flotation (LPF) circuit; (2) construction of sponge iron and sulphuric acid production facilities; and (3) construction of a new smelter.

The above projects were undertaken as a planned program which was focused on the problem of prolonging the life of Ray Mines Division. They also better equip Kennecott to successfully compete in world copper markets with a lower grade ore. The story doesn't end here. Still underway is a major expansion to the concentrator at Hayden, Arizona. Under this program, the capacity of the mill will be increased from its present 15,500 tons per day to 22,500 tons per day. By the time that the mill expansion is completed (January 1961), the expenditure on the metallurgical projects will total about $40,000,000.

The new smelter is capable of treating up to 1,000 tons per day of combined copper sulphide concentrate, LPF concentrate and cement copper recovered from leaching facilities at the Ray open-pit mine. It can produce up to 240 tons of 99.5 percent copper anodes each day. Completion of the smelter project resulted in complete integration of the ore to metal cycle at Ray Mines Division with the exception of final refining. All metallurgical processing can now be manipulated to yield the most efficient results.

1. LPF Was The Key to Oxide Recovery

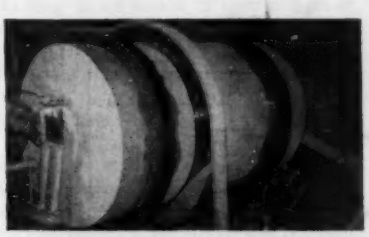
Conversion of the Hayden, Arizona, concentrator to the leach-precipitation-flotation process (LPF) was the first major project to reach completion at Ray Mines Division. It cost Kennecott nearly $5,000,000 to modify the mill, but the recovery of copper has been increased by approximately two pounds per ton of ore treated. The LPF process complements the conventional sulphide flotation circuit which existed at the Hayden mill prior to the change. The LPF treatment is aimed directly at improving the recovery of non-sulphide copper from the Ray ore.

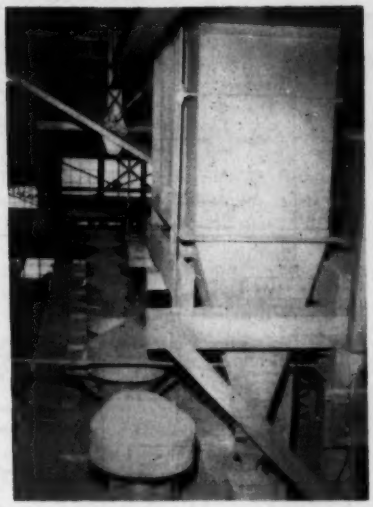
For many years, mining had been conducted underground at Ray, and recovery of copper minerals from the so-called oxide family had never been a problem. When the underground ore was approaching exhaustion, an open pit was developed at Ray. The deposit developed by the open pit is partially oxidized. Ever since the underground mine was closed in 1955, the open pit has furnished the feed to the mill.

It was known that sulphide flotation would make a poor recovery of the non-sulphide fraction of the Ray ore. Fortunately this problem was anticipated, and as far back as 1952, personnel at Kennecott's Western Mining Division's Research Center at Salt Lake City began studying alternatives to sulphide flotation. Prior to modification of the Hayden mill, test work indicated that in "average" schist type Ray ore containing 0.27 percent non-sulphide copper, the LPF process would recover an average of two additional pounds of copper per ton of ore.

The LPF circuit has been in operation at the Hayden mill for nearly 2½ years. Results to date have confirmed the test work. Metallurgical recovery of total copper in the feed has advanced from approximately 75 percent to better than 85 percent since the change.

In over-simplified terms, the LPF process simply converts a portion of the copper oxides to metallic copper which will respond to flotation. The process starts by making a sand-slime separation of a rod mill discharge. The sands are leached in drums and washed counter-currently. The washed sands then advance through fine grinding and sulphide flotation where a butyl xanthate collector is used. The slimes are leached in a wooden tank which also receives pregnant solution from sand leaching. Sponge iron is then added to the slime pulp to precipitate copper which is then recovered by flotation in an acid circuit.





TOP LEFT: Four brick-lined leach drums contact acid with the sand fraction of rod mill discharge products at the mill. BOTTOM LEFT: Cyclones scrub copper sulphide flotation tailing prior to pyrite flotation. RIGHT: A view of one of the four lines of copper precipitators; sponge iron is added from hoppers.

Both sulphuric acid and sponge iron are essential ingredients for the LPF process. About 8 pounds of acid and four to six pounds of sponge iron are required per ton of mill feed.

To make the Ray concentrator completely self-sufficient with respect to raw material, a pyrite flotation circuit was added to the mill. The pyrite concentrate is roasted in a fluid bed reactor to produce gas for a 100 ton-per-day contact acid plant. The reactor calcines are reduced with coal to produce the sponge iron. The success of the LPF process is dependent on the economic production of a minus-28-mesh sponge iron. Sponge iron facilities are described in a following chapter.

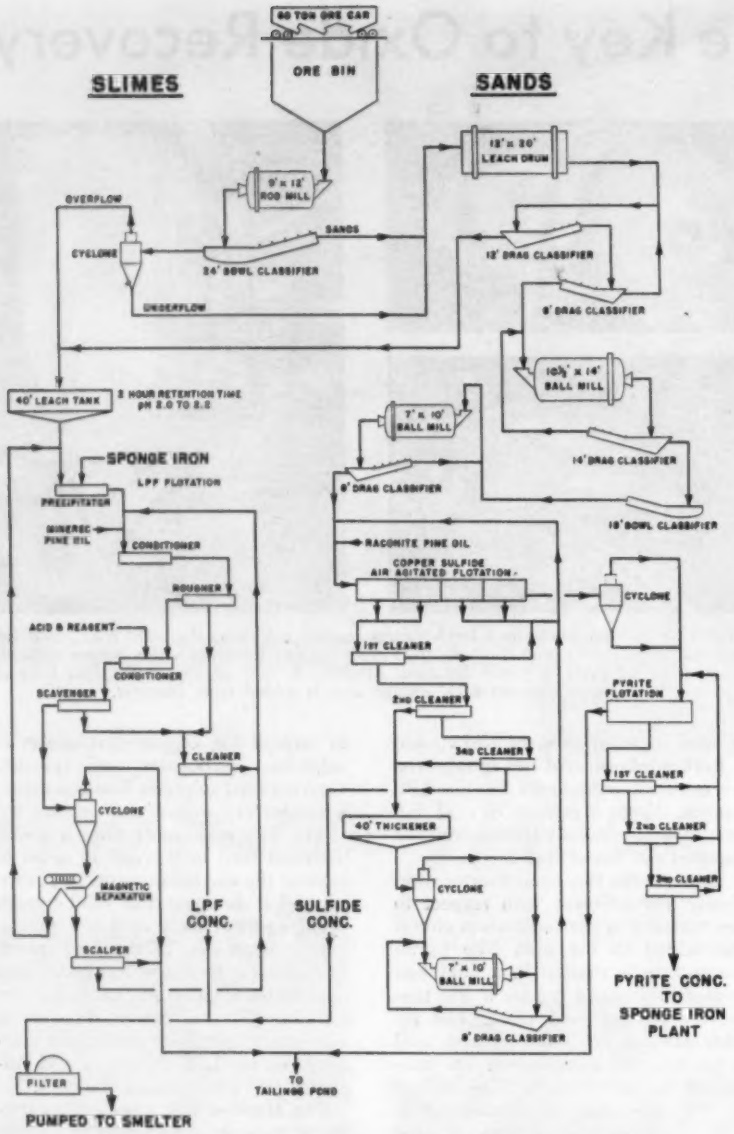
The Ray orebody consists principally of schist, with intrusions or quartz porphyry and diabase. The schist and porphyry are partially oxidized, but the diabase is relatively free of oxidation. Processing of the diabase by the LPF method is not necessary, but this ore contains the pyrite that is needed for the production of acid and sponge iron.

The schist and porphyry ores are mineralized principally with chalcocite. The predominant mineral in the diabase is chalcopyrite. Non-sulphides, however, compose about 20 percent of the schist ore. Prominent minerals in this group in order of decreasing importance are copper silicates, cuprite, malachite, tenorite, and native copper. The LPF process was designed to recover the copper that occurs as sulphates, carbonates, and silicates. Conventional sulphide flotation makes a satisfactory recovery of cuprite.

The Ray mine must furnish a well balanced feed to the mill in order to achieve the maximum recovery of copper and at the same time yield enough pyrite to meet daily acid and sponge iron consumption of the LPF plant. The diabase furnishes the pyrite and contributes copper sulphides for the sulphide flotation circuit. The schist and quartz porphyry contribute non-sulphides for LPF treatment and sulphides for conventional flotation.

The Hayden mill is presently capable of treating a maximum of 16,000 tons of ore per day. At this rate, approximately 12,000 tons report to sulphide flotation following the sand leach. The remaining 4,000 tons are processed through the LPF circuit.

Incoming ore is treated in four parallel grinding, classification, and sand leaching circuits. The ore is ground to minus-3-mesh by a 9-by 12-foot rod mill in each section. A small amount of lime is added to the rod mill to neutralize the acidic nature of the feed and thus reduce rod and liner wear. The rod mill product of each section reports to a 24-foot bowl classifier. The bowl classifier makes a preliminary sand-lime separation. Cyclones, however, were added to further classify the overflow from the bowls. Their main function is to remove the maximum amount possible of plus-200-mesh material from the bowl overflow.



Flowsheet Hayden Mill—Capacity 16,000 Tons Per Day

This treatment helps reject traces of copper sulphides from the slimes which then report for leaching in the LPF circuit.

Overall mill recovery of copper is improved by the cyclones since any of the fine sulphides taken out of the LPF feed are later treated in the sulphide flotation circuit where recovery of copper sulphides is more efficient. The oxides contained in the cyclone spigot are not lost because the underflow is contacted with acid in the sand leach circuit before it enters sulphide flotation.

The sands from the bowl classifiers and the cyclone underflow are combined for delivery to a 12- by 20-foot leach drum in each section. The leach drums are lined with acid resistant brick, contain spiral lifters, and provide a total retention time of 10 to 13 minutes. Fresh acid is added to the leach drums. In each section, the sands discharged by the drums are washed counter-currently in two rake classifiers in series. The classifier tanks and rake arms are rubber-covered. The flights are made of stainless steel. The overflow from the first washing classifier is taken to the slime leaching tank in the LPF circuit. The sands from the final washing classifier are ground with lime in two stages and then directed first to the copper sulphide flotation circuit and then the pyrite flotation circuit.

Tests are being conducted using cyclones to treat the sands from the final washing classifier. This is being done to further reduce possible soluble losses of copper to the sulphide flotation circuit.

The feed to the slime circuit consists of the pregnant overflow pulp from the washing classifiers in the sand circuit, and the cyclone overflow from the rod mill classification circuit. These products from the four mill sections are combined and fed to a 40-foot-diameter wooden tank. Additional acid may be fed to the tank if necessary, and agitation is maintained by means of circulating pumps. This tank provides a total contact time of approximately two hours. The concentration of copper in solution is variable according to the type of ore being treated.

Precipitation, conditioning, roughing and scavenging in the LPF section are carried out in four identical and parallel lines of mechanical flotation cells. The feed from the slime leaching tank is divided among the four lines.

The dissolved copper is dropped from solution by addition of virgin sponge iron and sponge iron reclaimed from the LPF flotation circuit. In each line, fresh sponge iron is added to the nine cells on precipitation duty from a hopper and vibrating feeder. The amount of sponge iron required is variable, within limits, depending on the concentration of copper in the pregnant feed.

Conditioning in each line is carried out in four cells. Minerec A and pine oil are added to the conditioning cells, and rougher flotation takes place in a bank of 11 mechanical flotation machines. The rougher tailing is reconditioned with pine oil and acid. The pulp is then scavenged in a set of mechanical flotation cells. Both the rougher and scavenger concentrates are joined for single-stage cleaning.

The scavenger tailing from flotation contains unconsumed sponge iron. It is reclaimed by passing the scavenger tailing through a set of six cyclones to deslime the pulp and then delivering the cyclone spigot products to a wet, belt-type, magnetic separator. The overflow from the desliming cyclones is discarded to tailings. The reclaimed magnetics are conditioned with raconite, a crude butyl xanthate made by Kennecott, and pine oil. This pulp is then subjected to flotation in a set of scalper cells.

The purpose of the scalper cells is to recover traces of coarse, heavy metallic copper and finely divided copper sulphides which may have escaped concentration in the acid circuit.

Grade of the LPF concentrate which consists of metallic copper sulphide fines ranges from 26 to 32 percent copper. It is combined with copper sulphide concentrate from the sulphide flotation section of the mill

for thickening. The thickened pulp is then pumped to the filter plant located at the smelter, a distance of about 2,900 feet.

Automatic sampling stations provide representative samples at several critical points in the LPF circuits. Acid addition is controlled by means of pH recorders and controllers. Approximately two-thirds of the total acid added to the circuits takes place at the sand leach drums. The remaining amount is metered ahead of the slimes leaching tank and at times to the scavenger cell feed. A sensing head at the slimes leach tank makes the necessary adjustment to the acid feed rate automatically at that point in order to maintain the optimum flotation condition.

The amount of soluble copper entering the LPF circuit is variable and is determined by operators who make hourly colormetric assays. Manual adjustments in the feed rate of virgin sponge to the precipitators are made according to the results of the colorimetric assays.

It should be emphasized that an excess of sponge iron is essential to the success of the LPF operation. This permits a circulating load of precipitant to remain in contact with the pulp at all times, thus preventing resolution of copper in the acid flotation circuit. The particle size of the sponge iron must be fine enough so that the material can be pumped and follow the pulp through the circuits. All virgin sponge fed to the circuits at Ray Mines Division is minus-28-mesh. As long as an excess of sponge iron is available, the acidity of the flotation circuit can be adjusted for optimum flotation conditions rather than for minimum re-entry of cement copper into solution.

Sponge iron also enables complete and fairly rapid precipitation of dissolved copper in a flocculated form suitable for recovery by flotation.

The sulphide circuit of the Hayden mill receives its feed from the washing classifiers which handle the discharge of the sand leach drums at the head of the LPF plant. The sulphides are ground and floated in Callow cells with a raconite collector. The copper sulphide concentrate is cleaned in three stages and combined with the LPF concentrate for delivery to the smelter by pipeline.

The concentrate pumping station, located in the mill building, receives the combined concentrates as slurries. The pulp is stored in two 20-foot diameter, agitator, holding tanks. From the holding tanks, the pulp is pumped through a 6-inch pipeline to the filter plant at the smelter.

Two sets of two, rubber-lined slurry pumps are used to pump the pulp. One set of slurry pumps is normally on stand-by status. The speed of the pumps, connected hydraulically in series, can be adjusted to produce variable flow rates.

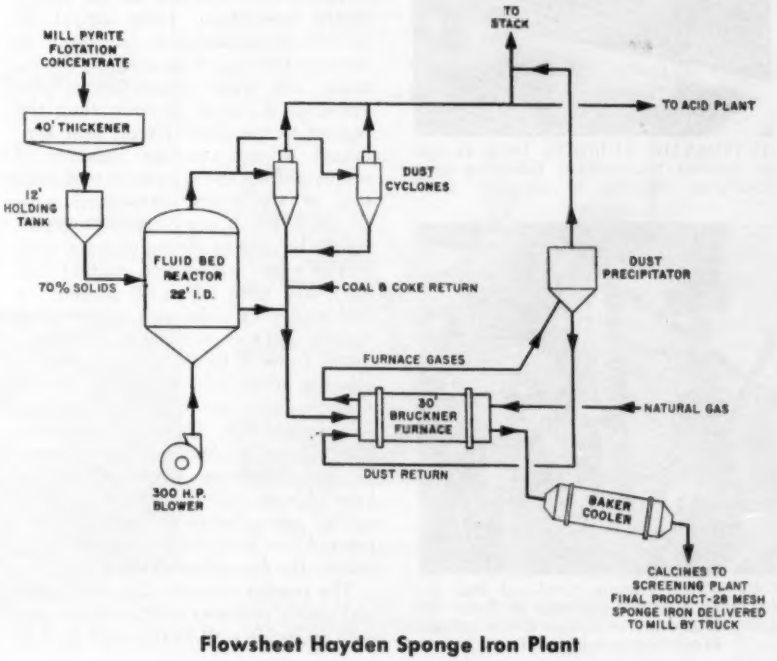
The 6-inch slurry pipeline, together with a spare and return line, is routed to the filter plant through a special, multiplate-steel-arch tunnel of nominal 5-by 7 feet in cross section. The tunnel, installed by the smelter contractor, is nearly 2,700 feet long. It contains a concrete floor, lighting, manholes, and wash-down stations. The underground opening was a necessary expedient because of interference problems with roadways and railroads on the surface. The slurry rises about 80 feet from the mill pumping station to the smelter filter plant. The delivery lines are equipped with automatic drain valves at the pumping end of the system. These valves are interlocked with the slurry pumps and open to drain the line in case of pump failure.

The LPF plant at Hayden employs one of the most unique processing methods for copper now in application today. The treatment represents a further example of the application of metallurgy to the problem of making ore out of low grade feed. It is one of the most powerful of the factors that allow Ray Mines Division to remain competitive with ore containing about 18 pounds of copper per ton.

2. How Sponge Iron Is Made For Mill

The success of the LPF process at the Hayden mill is dependent on the economic production of sulphuric acid and sponge iron. Both of these ingredients are produced at a centralized location about 1,500 feet from the mill. The primary components of this system include: (1) a 22-foot diameter fluid bed reactor; (2) a 100-ton-per-day package contact acid plant; and (3) a sponge iron plant consisting of two Bruckner furnaces, two Baker coolers and associated crushing and screening equipment.

The fluid bed reactor roasts a 40 percent iron pyrite concentrate which is delivered from the mill by pump and pipeline to a 40-foot diameter thickener serving the reactor. The pyrite is burned in the reactor yielding gas in excess of the 9,000 cubic feet of 7 percent SO_2 needed for the 100-ton-per-day acid plant. The reactor produces a hematite calcine for reduction in the sponge iron plant which has a daily output capacity of 60 tons of 50 percent sponge iron.



Flowsheet Hayden Sponge Iron Plant

Reactor Components

BED OVERFLOW PIPE is insulated against heat losses. Overflow is tapped at two points on the reactor.

REACTOR FEED GUN contains water and air connections; air atomizes the slurry and water controls temperature.

AUTOMATIC BURNERS bring reactor to ignition temperature following long shutdown; roasting is normally autogenous.

GAS SEALS contain dead-end legs divided by vertical partition to form U-tube; air injected at bottom forces calcine to overflow one leg of the U.

A fluid bed reactor was selected to roast the pyrite because it was felt that it offered maximum flexibility for the operation. The reactor is efficient at variable levels of production and it lends itself to fairly complete instrumentation and control.

Since the Hayden milll may go through periods of prite starvation, provisions were made to stockpile, reclaim and repulp pyrite concentrate at the reactor site. Normally the concentrate is pumped at about 15 to 20 percent solids to the thickener. The thickener overflow is returned to the mill, and the underflow at 65 to 70 percent solids is pumped to one of two 12-foot diameter air and rake-agitated holding tanks for the reactor. When excess pyrite is produced at the mill, the thickener underflow can be diverted to storage bins or to earthen ponds. Dried, stockpiled pyrite is reclaimed by a front end loader, when needed, and sent to a pug mill by conveyor. From the pug mill, the repulped pyrite can be pumped to the thickener or to either one of the two holding tanks serving the rector.

Wet pyrite is pumped from the holding tank and introduced through the side of the reactor one-foot above the bed level by means of a feed gun. Normally one tank and one gun is furnishing feed at any one time. The pyrite is fed to the reactor as a slurrry containing about 70 percent solids. The calorific power of the pulp is normally more than sufficient to sustain an autogenous roasting reaction. The unit is operated under dead roasting conditions to yield a calcine containing less than one percent sulphur.

Each feed gun has an air and a water connection. Plant air at 50 pounds-per-square-inch is used to atomize the slurrry as it enters the reactor. The water connection is provided as a means of controlling the reactor temperature. Excess heat generated in the reaction chamber is removed from the system by vaporization of the water introduced with the feed. The water connection is useful for helping to clear a plugged gun.

The pyrite has an iron content that may vary from 34 to 46 percent. It will contain a little over one percent copper and the insoluble content will range from 4 to 24 percent. Every effort is made to blend the dry pyrite concentrate to less than 15 percent insoluble content. This will minimize slagging and agglomeration conditions in the Bruckners (modified rotary kilns) where the calcine is reduced to sponge iron at below-melting temperatures. A low insoluble content will also reduce the formation of rings.

The reactor consists of a cylindrical and totally enclosed mild steel camber with an inside wall 14 feet high that is lined with heavy duty fire brick. The outside wall is completely insulated to minimize heat losses. At the bottom of the chamber is a horizontal stainless steel constriction plate containing tuyeres spaced on 10-inch centers. The tuyeres are made from stainless steel castings and each one contains four ¾-inch holes. They are screwed to threaded couplings in the constriction plate. Fluidizing air is introduced to the reactor from a windbox below the constriction plate. Low presssure air is furnished by a 300-horsepower blower that has a capacity of 12,000 cubic-feet-per-minute.

The reactor chamber and windbox assembly are supported above ground level by means of H-beam columns. This provides sufficient head room so that calcine can be taken to the sponge iron plant by gravity. A centralized instrument and control center is provided in the reactor super-structure which also contains appropriate walkways leading from ground level to the dust collection system on top.

The reactor was designed for operation using a 4-foot deep fluidized bed. The calcine is recovered as bed overflow and as dust collected from hot cyclones on the gas stream. The reactor is equipped with two 3½-foot diameter top ports through which the gas produced by the reaction is taken from the chamber. A separate flue leads from each top port to a set of two cyclones arranged in series. The cleaned gas effluent from each set of cyclones is joined at a junction box for delivery to the acid plant through a single flue system. The reactor is under pressure from the windbox below the constriction plate, through the cyclones and to a point midway between the cyclones and the adjacent acid plant. The cyclones are normally operated under a pressure of 0.5 inches of water.

The bed overflow is taken from the reactor by means of two insulated stainless steel pipelines. Each bank of cyclones and one bed overflow pipeline feeds one of the two Bruckner furnaces. The calcine is discharged from the cyclones and the bed overflow pipelines through special gas seals. Approximately 85 percent of the total calcine fed to the Bruckner furnaces is recovered by the cyclones. The remaining 15 percent is removed from the reactor as bed overflow.

The original design capacity of the reactor was 180-tons-per-day of dry pyrite. The reactor bed temperatures are held at approximately 1,600° F. A temperature of at least 1,350° F. is required before the reactor can be started on pyrite feed. With but one Bruckner operating, the reactor feed rate is normally held between 3.0 and 3.5 tons-per-hour depending on the

grade of the pyrite and the gas demands of the acid plant. With a feed rate of 3.0 tons-per-hour and with one bank of cyclones operating, approximately 1.7 tons-per-hour of hot calcines are discharged to the Bruckner furnace.

The reactor is operated by a combination of manual and automatic controls. The pulp density of the pyrite slurry is determined at several points by means of pulp balances. The amount of fluidizing air is selected manually and is controlled automatically at the pre-selected level. Pressure taps indicate the condition and depth of the cyclone pressure. Thermocouples relay information as to the regulation and functioning of the cooling water and of the operation of the gas seals on the bed overflow ports and cyclones.

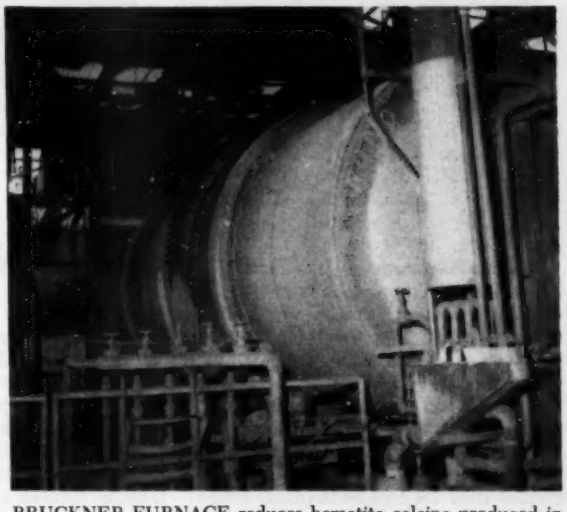
Most of the instruments for control are located at a centralized panel. On the instrument panel, an air-flow recorder is inter-connected to a manually set, remote, air valve controller. An indicating ammeter shows the amount of electric current being used by the motor that drives the air blower. A five position indicating draft gage shows the hydrostatic head of the fluid bed, the freeboard space pressure, the windbox presssure, and the entrance pressure at the cyclones. A six point instrument records bed temperatures at three locations, the freeboard temperature, and cyclone entrance temperature. Another six point instrument records temperatures in each of the six gas seals of the calcine discharge ports. A sudden drop in temperature at any one of the gas seals is an indication that the hot calcine is not flowing properly. A single point temperature recorder and controller regulates the bed temperature automatically. If the temperature control is on manual operation the latter unit merely records the bed temperature.

An Orsat analyzer has been used

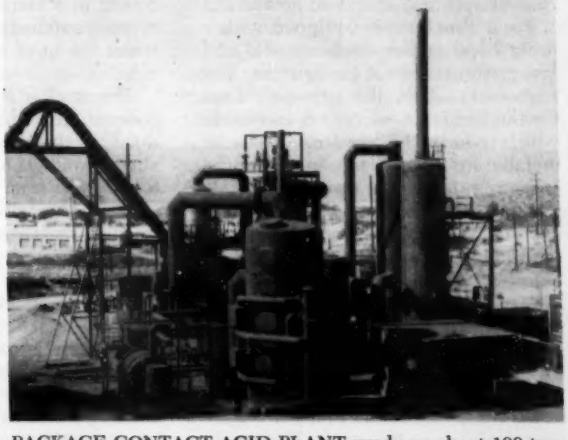
Operating Data at Sponge Iron and Acid Plants

Feed analysis of pyrite concentrate	
percent iron	**34 to 46**
percent copper	**1.05 to 1.70**
percent insol	**4 to 20**
Feed rate to reactor (tons per hour)	**3 to 3.5***
Volume of gas produced (7 percent SO_2 ambient conditions)	**12,000 cfm**
Calcine produced (tons per hour)	**1.7**
Acid production per day (tons)	**100**
Sponge iron produced per day (tons)	**39 to 42**
Metallic iron content of sponge iron	**35 to 50**
Total coal fed to Bruckner based on 100 TPD of pyrite feed (tons per ton of pyrite feed)	**0.25 to 0.30**
Coke recovered from cooler product which is recovered and recycled (percent)	**15**
Size of sponge iron	**minus 28 mesh**

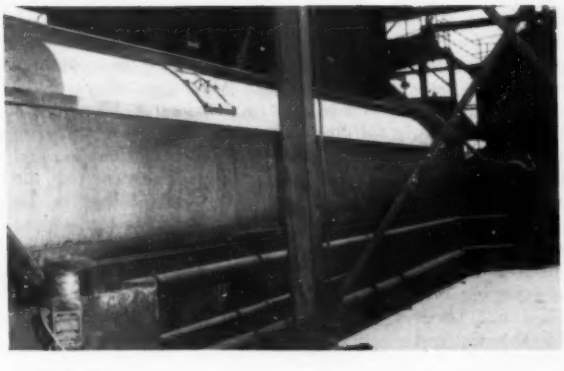
***when only one Bruckner furnace is operating.**



BRUCKNER FURNACE reduces hematite calcine produced in the fluid bed reactor at below melting temperature. One method of controlling ring formation is by feeding excess coal.



PACKAGE CONTACT ACID PLANT produces about 100 tons per day of H_2SO_4. It takes about 9,000 cubic feet per minute of 7 percent SO_2 from the reactor. (Above)



BAKER COOLER revolves in a water bath and contains seals to maintain a reducing atmosphere. Unless carefully controlled, re-oxidation of sponge can become a problem. (Left)

for checking the gasses at the junction box handling the gas effluent from the cyclones. This has been replaced by a remote recorder which is mounted on the instrument panel. In normal operation, 1.5 to 2.0 percent O_2 in the gas stream at the junction box is an indication of a good quality SO_2 product for the acid plant and a desirable hematite calcine.

Heat can be held in the reactor during long periods of down-time. A reactor can be started without the use of auxiliary burners following an inactive period of up to 72 hours. After prolonged down-time auxiliary, automatic, natural-gas fired burners must be used to heat the bed and chamber to a minimum starting temperature of 1,350° F.

The sponge iron plant is arranged in two parallel circuits for reduction of the calcine and for cooling the sponge iron. One or both of the circuits may be operated at any one time. The calcine, minus ½-inch coal, recovered flue dust and return coke are fed into the Bruckner furnaces through gravity feed pipes. The coal, flue dust and return coke are brought into the feed pipe system beyond the gas seals on the reactor calcine lines.

A Bruckner furnace is a modified rotary kiln having narrow feed and discharge openings. This feature permits a deep bed to build up in the furnace. At the Hayden sponge iron plant, the Bruckners are 8 feet in internal diameter and 30 feet long. They are lined with high heat-duty firebrick. The throat at the discharge end is 2⅛ feet in diameter, thus a bed slightly greater than 2⅛ feet in depth can be maintained in the furnace. The furnaces rotate at one-revolution-per-minute and this provides a retention time of approximately two hours.

Each Bruckner is equipped with a firing hood at the discharge end and low pressure natural gas burners. The burners maintain the necessary heat for the formation of carbon monoxide which reduces the hematite calcine to metallic iron. A balloon flue takes the gaseous products of combustion to a 200-foot high stack serving the roaster and the sponge iron plant. The stack also handles minor amounts of excess SO_2 that are produced by the fluid bed reactor and which are in excess of acid plant requirements.

A multiclone installation ahead of the stack cleans the gas stream of 95 percent of the dust load. The sponge iron system experiences only a 5 percent dust loss to the stack. The specifications of the stack fan limit its trouble-free operation to temperatures of 1,000° F. or less. A recording thermocouple is located on the flue line ahead of the stack fan and water spray heads have been installed on the balloon flue. Cooling water is turned on manually by the operators if the gas temperature begins to approach the "critical" point.

The temperature in the Bruckners is manipulated according to operating requirements. Control can be exercized by means of variation in coal and calcine feed rates and by variation of the firing rate at the burner end. Reduction of the hematite calcine takes place below the melting point of the charge. The tendency for rings, balls, and other large size agglomerates to form has been reduced to a point where they are no longer troublesome. The bed temperature in the furnaces may vary from 1,500° F. to above 1,800° F. Reaction rates proceed at a good rate at about 1,800° F., but if the insoluble content of the calcine is high the temperature may have to be reduced to about 1,500° F. to minimize slagging and balling.

The Bruckners discharge the hot sponge iron through the firing hood to water cooled chutes that feed the two gas-tight Baker coolers. The lower part of the Bruckner firing hood is flooded with natural gas as a precaution against re-oxidation of the hot sponge iron.

The Baker coolers are each 7 feet in diameter and are 40 feet long. They rotate at four revolutions-per-minute in a water bath that extends along the bottom axis of the cooler. Maintenance of a reducing atmosphere in the coolers is important to the prevention of re-oxidation of sponge iron. At the feed end the rotating cooler shell is in contact with a stationary seal made of brake lining material. The inside of the feed end has a simple hinged flap valve which opens under the force of the hot sponge iron discharged from the Bruckners. The cooled sponge iron is discharged from the Baker cooler through a spring-loaded valve. The sponge iron is delivered from the end of the coolers to a system of conveyors by gravity. The belts convey the product to a crushing and screening plant where the sponge iron is sized to minus-28 mesh and excess coke is recovered.

3. Space For Expansion Is

By Ralph Johnson
Western Knapp Eng. Co.

Kennecott Copper Corporation's new smelter at Hayden was designed for green smelting practice. The basic metallurgy involved in treating the feed is similar to that prevailing at other smelters handling wet copper sulphides. The new plant, however, represents a summation of present day trends in materials handling arrangements, automatic control and functional layout of equipment and buildings.

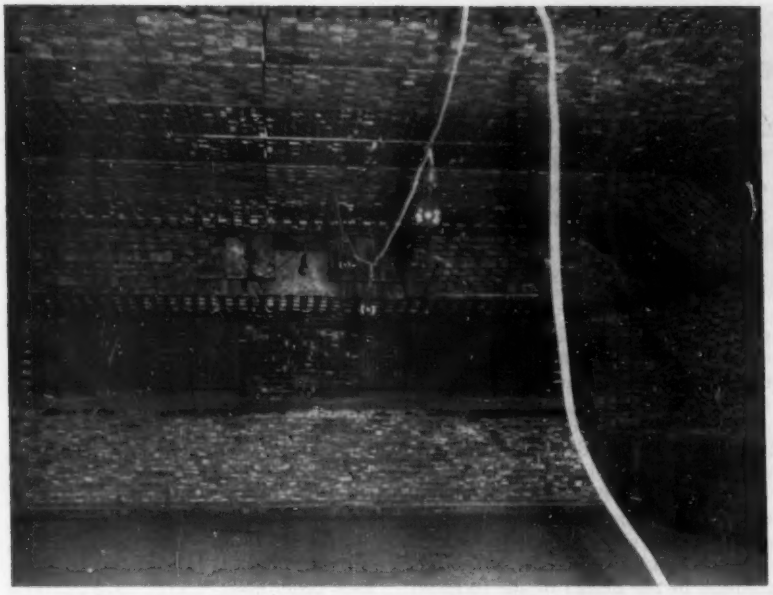
The smelter treats copper sulphide concentrate and LPF concentrate produced at the Hayden mill. Both of the above products are pumped as a combined pulp from the mill to the filter plant at the smelter. In addition, the smelter treats cement copper precipitate delivered by railroad cars from the mine at Ray.

The filter plant receives the slurry from the mill and dewaters the concentrate by means of hydraulic cyclones and dual-vacuum disc filters. The filter plant was designed for automatic operation. Controls are arranged for automatic shut down in the event of equipment failure.

The slurry is pumped by two sets of two rubber-lined pumps to a tapered cyclone manifold. One pumping unit is normally on stand-by status. Three cyclones are fed from the tapered manifold at 20 pounds-per-square-inch-gauge inlet pressure. Normally, two cyclones are in operation with the third on stand-by. Cyclone feed is at a rate of 490 gallons-per-minute for 1000 dry-tons-per-day of concentrate. Cyclone underflow of approximately 74 gallons-per-minute at 70 percent solids combines with the underflow from the thickener, 50 gpm at 60 precent solids, to form the feed for the vacuum filters. Cyclone overflow of approximately 416 gpm at 11.8 percent solids is laundered to an 80 foot diameter thickener.

Three separate filtering circuits are employed to receive the underflow from the cyclones and thickener. Normally, two are in operation with the third on stand-by. Each filter is a 6-foot diameter by 8-disc machine with 400-square-feet of filter area. The design rate of the filters is 105 pounds of filter cake per square foot per hour, and all filters discharge to a common collector belt. Moisture content of the filter cake approximates 10 percent. Filtrate from the filters is returned to the thickener for final clarification and thickener overflow is returned to the mill through the return line in the pipe tunnel. The cake is weighed and conveyed to the concentrate storage building or to an outside storage area.

The concentrate storage building contains three 2,000-ton concrete bunkers for concentrates and one 500-



REVERBERATORY INTERIOR shows details of construction. This view looks toward the dutch oven at the firing end and shows eight multiple burners. Note the opening on the arch centerline for the single slag-return launder.

CONVERTER AISLE at smelter shows the three 13-by 30-foot units at left and the two anode furnaces in the background.

Provided at New Smelter

ton bunker for cement copper precipitates received by gondola car from Kennecott's leaching plant facility at Ray, Arizona. The mixing of precipitate with concentrates and the reclaiming from storage is accomplished with two 10-ton capacity, overhead traveling, grab-bucket cranes. Each is complete with a built-in 14 cubic-yard hopper that is unloaded by means of a 48-inch belt feeder. The hopper is suspended below one end of the crane and rigidly fastened to the bridge. The hopper is spotted over a 24-inch gathering conveyor which is oriented in the direction of crane travel. Feed drawn from the hopper to the conveyor belt is under the control of the crane operator. With a minimum of crane movement, the operator is able to charge the hopper with concentrate reclaimed by the bucket.

Lime rock flux, from a 350-ton capacity outside storage bin, is added in predetermined amounts to the reclaimed concentrate on the gathering conveyor. Concentrate from outside storage, transported by front-end loaders and a belt conveyor, is also discharged to the gathering conveyor where fluxing is accomplished. From the concentrate storage building, the concentrate is handled by a system of belt conveyors which terminates at two 490-ton capacity storage bins located over the reverberatory furnace.

A centralized crushing and conveyor system is utilized for the handling of all fluxes and smelter reverts. The crushed products are delivered by tripper conveyor to separate outside storage bunkers. Mine-run silica rock, received in gondola cars from the pit at Ray, is dumped at ground level through a 24-inch grizzly into a 250-ton capacity track hopper. From the hopper, the silica rock is fed by a manganese apron-feeder to a jaw crusher for primary crushing. The crusher discharge is then fed by belt conveyors to a deck screen ahead of a hydro-cone crusher. The undersize material from the screen is combined with the cone crusher discharge and is conveyed to outside storage by a tripper conveyor.

Lime rock and smelter reverts are delivered to the crushing plant by truck and are dumped through a special truck-sized door into the track hopper. Crushing of lime rock is similar to silica rock except for a finer setting of the cone crusher. Lime rock is normally crushed about once a week.

The resulting dangers of accidentally mixing lime rock with the silica rock used for converter fluxing were given careful consideration in the design. (Lime in converter feed would produce violent boiling.) An interlock system was developed which would require the outside storage tripper to be located over the lime rock storage pile before lime trucks could dump into the track hopper, and before the crushing plant could be started. Interlocks were also provided on all belt conveyors to prevent material spillage and belt damage in case of a breakdown.

Lime rock is reclaimed from the storage pile by front-end loaders and trucks which transport it to the lime storage bin adjacent to the concentrate storage building. Silica rock is reclaimed through draw-down gates in a reclaim tunnel beneath the storage pile. It is transported by a system of belt conveyors to either the storage bin for the reverberatory furnace or to the storage bins behind the converters.

Green smelting of the concentrate is accomplished in a 35-foot wide by 120-foot long (outside dimensions) all basic-refractory reverberatory furnace with a Dietrick-type suspended arch. The concentrate and lime are transported from two 490-ton capacity storage bins, located above and to the sides of the furnace, by a feeder-belt system which ultimately feeds two traversing-type shuttle-belts. The shuttle-belts are located on top and to the sides of the reverberatory arch, and traverse the length of the furnace.

Typical Data and Results at Ray Smelter Per 30 Day Month

Tons copper concentrate smelted .	27,794
Tons copper precipitate smelted .	1,075
Tons converter flux smelted . . .	6,003
Tons copper anodes produced . .	5,745
Gross BTU's per ton NMBM (furnace)	6,500,000

Product Analysis	% Cu	% Fe	% S	% SiO_2	% Al_2O_3	% CaO
Copper Concentrate	15.4	31.0	36.9	11.0	4.3	Nil
Reverberatory Slag	0.34	36.1	1.3	37.6	9.6	3.5
Converter Slag .	2.35	49.1		25.2	5.4	0.1
Matte	27.2	40.7		0.8	1.3	Nil

Control of the conveyors is from push-button panels mounted directly on the conveyor frame. The panels are readily accessible to the operator. Besides traversing back and forth, the belt of each shuttle-conveyor is reversible, thereby enabling the conveyors to charge concentrate directly over the head pulley, or tail pulley, to any of the sixty-four (32 per side) furnace charge hoppers located immediately below.

Although this particular installation is not the first of its kind, it is felt to be a refinement in the general design which uses a system of conveyor belts to feed a reverberatory furnace. The entire top of the furnace, including the boiler up-take, is also free from obstructions. This feature permits easy fettling and arch maintenance using one 5-ton capacity overhead crane.

The furnace charge hoppers are arranged in a row above and along each side of the furnace. They are nominally 3 feet square at the top, are closely spaced, and taper to approximately 9 inch square at the arch line. The concentrate is admitted to the furnace by means of a slide-gate assembly which is bolted to the hopper. The slide-gate is controlled by a lever arrangement which is actuated by the operator charging the furnace. The slide gates are self-cleaning and plug-proof.

The reverberatory furnace is constructed on a massive and heavily reinforced, concrete foundation which extends some 12 feet 4 inches above the surrounding grade. The foundation is of the floating type to allow for thermal expansion and encloses the furnace bottom, which consists of compacted clay, crushed magnetite and fused slag. Side wall thickness ranges from 4 feet below bath level to 1½ feet above. The cross-section of the furnace is constant throughout the entire length, and arch thickness is a nominal 15 inches. Worthy of special mention in the design of the furnace is an air-cooled, up-take pilaster, and a "dutch-oven" extension to the burner end of the furnace. The up-take pilaster brickwork has internal slots through which air is blown for refractory cooling purposes. The "dutch-oven" extends some 8 feet out from the furnace bridge-wall and is approximately 27 feet long. Eight multiple-jet type combination oil and natural gas burners are supported at the end of the "dutch-oven". The "dutch-oven" offers the advantages of higher smelting zone temperatures in the furnace and better combustion and heat release of the fuel.

The air for combustion (50,000 cfm at 60° F.) is heated to approximately 650° F. by a counter-current, regenerative-type air preheater installation which is complete with a direct-fired natural gas furnace. Control of the preheater and furnace is completely automatic except for manual light-off of the furnace burners.

Slag can be tapped from both sides of the reverberatory furnace, near the up-take end, and is transported by launder to 225-cubic-foot slag cars. Matte is tapped from either side of the furnace near the burner end and is transported in 200-cubic-foot ladles by self-propelled transfer cars to the converter aisle. Separate fume control systems are provided at each furnace tapping location to exhaust all fumes to the atmosphere. Converter slag is returned to the reverb furnace by one launder which is located on the furnace centerline.

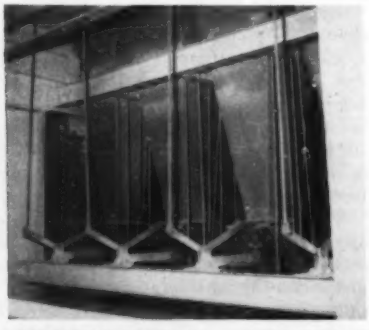
The reverberatory installation includes two waste-heat type steam generating boilers. Each boiler is rated at 66,000 pounds of steam per hour, 450 pounds-per-square-inch-gauge and 750° F.

From the converter aisle, the 200-cubic-foot matte ladles are hoisted from the transfer cars by one of the two 60-ton capacity, overhead-traveling, converter-aisle cranes. The cranes, each equipped with two 20-ton auxiliary hoists, transport and charge the matte to one of three 13-foot diameter by 30-foot long Pierce-Smith type copper converters. Two of the 65-ton capacity converters are operated normally with the third on stand-by. The converters are lined with 18-inch burned-chrome magnesite refractories and are equipped with 48 automatic-pneumatic type tuyere punchers, Converter air (25,000 cfm at 18 psig) and puncher air (100 psig pressure) are delivered to the converters from the powerhouse. The converters are driven at 0.6 rpm by a 75 HP motor, and the drive arrangement of each includes an air-operated emergency turn-out mechanism.

Each converter is controlled locally from an operator's console located at the converter. The air for the converters can be controlled from this console or remotely from the powerhouse. The tuyere punchers can be operated electrically by a timing mechanism or they can be operated manually, as desired.

A new development in converter spark-shields is another interesting design feature. Each converter is equipped with a spark-shield which not only affords the necessary protection from falling sparks, but also provides ventilation for the puncher operator.

REVERB is fed by reversible shuttle belts. Top of furnace is clear of obstructions for easy fettling.



CHARGE HOPPERS on reverb take feed from shuttle belts and introduce it to the interior through guillotine gates.

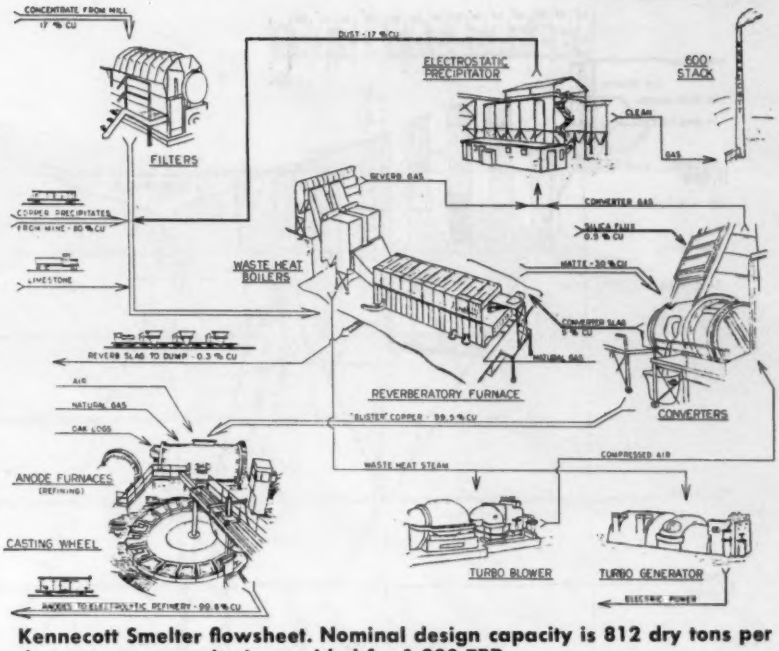
Mounted at one end of the shield is a 1600 cfm axial-vane fan. This fan operates continuously to blow air into a long, dead-end tube, which is a part of the shield, and the tube in turn directs the air, through holes, to the operating area. In addition, when the converter is out of the stack and the shield has covered the tuyeres, the long tube is in a position to direct the cooling air directly on the punchers and actuating mechanisms.

The system employed for hoisting the converter rolling-door and the converter flue-damper represents an improvement. In the past, practice has been to hoist the total load of these items, or nearly so, with a bulky hoisting system involving a massive, specially machined and grooved, hoisting drums with a jack-shaft type of driving mechanism. The design of the hoisting system used at the Hayden smelter was patterned after the freight-elevator principle. Nearly all of the direct loads are balanced by counter-weights. The remaining load is handled very easily by a relatively small, electric hoist of standard design.

The blister copper received from the converters is charged to the anode furnaces. Each of the two, 13-foot diameter by 30-foot long furnaces is identical with the basic converter design previously discussed, with the exception of the tuyeres, air-piping, spark-shield, apron, spout and charging-hold configurations. The 250-ton capacity furnaces are grouped around one common anode casting-wheel. Poling of the furnaces, to rid the blister-copper of excess oxygen and other wastes left over from the converter operation, is accomplished by inserting oak-poles into the furnace bath using a special system of electric and air-operated poling hoists. The control of the furnace being used, and of the casting-wheel and pouring spoon, is from one of two control booths. These booths are completely enclosed, air-conditioned and are equipped with push-button type control panels. The casting-wheel is a flat-deck type, 32½ feet in diameter, and has provision for casting twenty-two 700-pound Baltimore-type copper anodes. The wheel is driven by two 5-HP D.C. motors and casting is at a rate of approximately 42 tons-per-hour.

After the anodes are cast, they are removed from the casting-wheel by a Bosh-crane and placed for further cooling in two Bosh-tanks filled with water. When the Bosh-tanks become filled with anodes, the anodes are lifted out and transported to a storage area.

The reverb and converter flues of the Hayden smelter are the familiar balloon-type, and are equipped with screw-conveyors to collect and transport the flue dust to a pug-mill. From the pug-mill, the flue dust is returned to the smelting process by belt conveyors. The flues are fabricated from all welded ¼-inch plate with ½-inch bar stiffeners, have accordion-type expansion joints on 21-foot centers, and are suspended from an overhead support structure by 1-inch diameter rods.

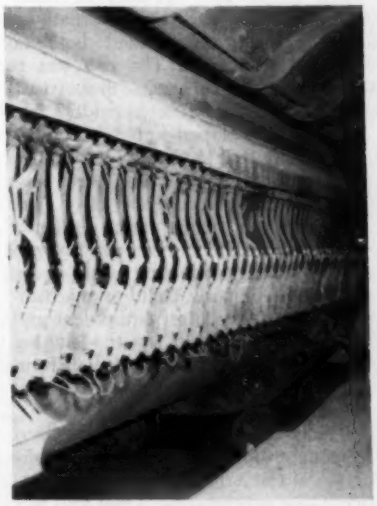


Kennecott Smelter flowsheet. Nominal design capacity is 812 dry tons per day; reserve capacity is provided for 1,000 TPD

The method of collecting dust from the flues represents an interesting feature. Instead of discharging dust directly into the screw-conveyor, which has been a past practice, the flue discharges into an "off-set" outlet which in turn connects to the screw-conveyor housing. The connection of the "off-set" outlet with the conveyor is completely flexible; it not only allows for relative movement of the flue in the vertical direction, but for horizontal movements as well. All conveyors are supported separately so that no stresses set up by the differential expansion of the flues can be transmitted to the conveyor structure. The outlet design also tends to eliminate the danger of large dust lumps, or flue liners, falling directly into and damaging the conveyor flights.

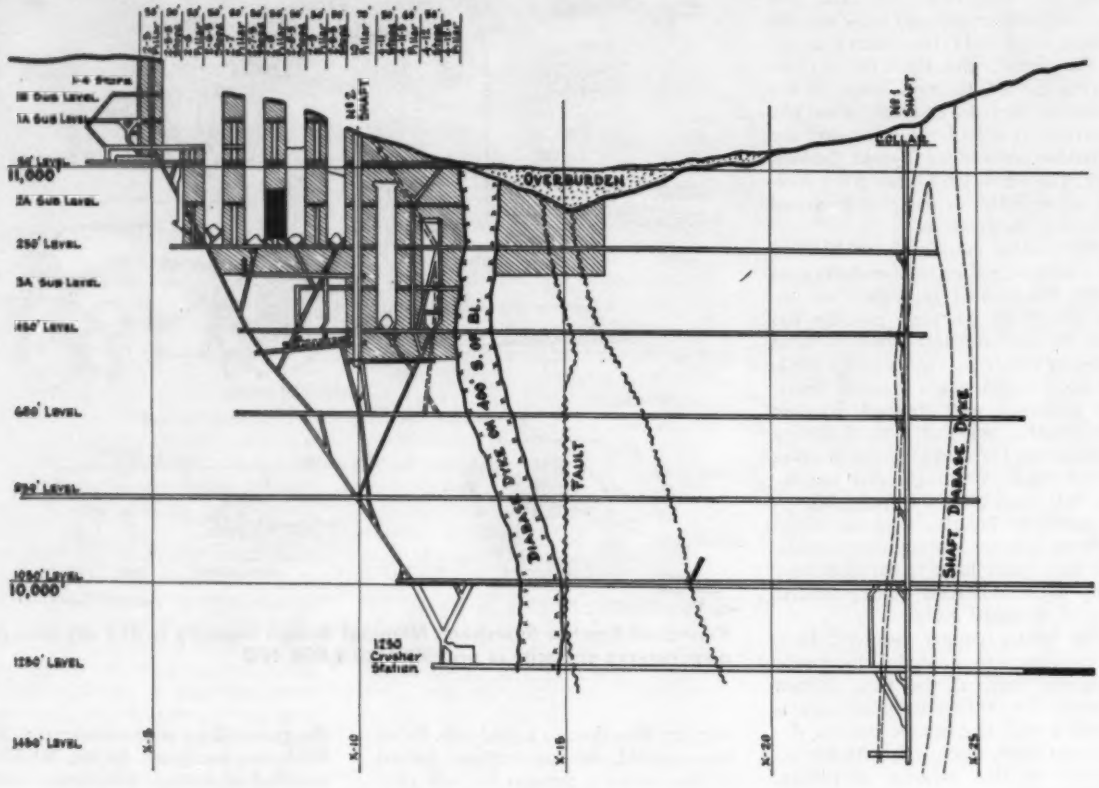
The reverberatory and converter flue gases are treated for final dust separation in a four-chamber, 60 gas duct, three-field type, electrostatic precipitator. The capacity of the precipitator is 300,000 cfm at 10 percent moisture and 500° F. All dust rappers are of the pneumatic type and the dust is collected and transported to the pug-mill by screw conveyors. The fields are energized by six, 30 KVA, double-half-wave, selenium power units. From the precipitator, the gases are channeled by a brick by-pass flue to a 600-foot high, brick-lined, reinforced-concrete stack.

The finished design of the Hayden smelter is felt to represent the latest in engineering thinking and reflects in its construction the "new ideas" and practical "know-how" of the entire copper smelting industry. THE END



CONVERTERS are equipped with mechanical tuyere punchers and a unique spark shield which protects punchers.

In Canada: Sub level blasthole stoping at Geco. Longitudinal section looks north



This Mine Was Designed To Eliminate

By Stanley H. Dayton
Associate Editor

Geco Mines Ltd. had an undeveloped copper-zinc orebody at Manitouwadge, Ontario, Canada that was comparatively strong and bounded by firm wall rock. The ore was in a nearly vertical vein that varied from 50 to 200 feet in width. The company developed a basic plan for extraction that virtually eliminated all necessity for tramming ore to the shaft and involved elements of bulk stoping methods for high yield per unit of labor. Since the deposit was planned for production starting in 1957, the company could take advantage of the very latest equipment and techniques available for the stoping problem. They could also benefit from the past experience of others in developing similar orebodies.

Today the mine developed by Geco is a fine example of progressive application of Canadian underground practice. Geco is producing 3,500 tons per day of 2.5 percent copper and 2.3 percent zinc ore. Output per underground manshift has grown to 25 tons, and for the total payroll (mine, mill, maintenance, service departments, surface labor and supervision), output is 8.5 tons per manshift.

Perhaps the most important aspect of this operation, however, is the fact that it is one of two newly developed mines located in a district that had been overlooked for many years. The Manitouwadge area is characterized by relatively small belts of pre-Cambrian greenstones. Though the greenstones of the Canadian Shield are generally regarded as favorable zones for mineral exploration, those near Manitouwadge did not compare in size with similar formations which had hosted great sulphide bodies at Sudbury, Noranda, Porcupine and other famous districts. Many geologists felt that the greenstones of the Manitouwadge district were so small in size that there was little chance of finding major sulphide deposits.

Since ore was first drilled at Geco in 1954, Willroy Mines Ltd., which borders Geco on the west, has been developed and equipped for a daily production of 1,000 tons. The district as a whole may have an ore potential sufficient to support one or two additional operations.

Geology

The country rock of the area is composed of pre-Cambrian volcanics, sediments, and igneous instrusives and diabase dikes. The ore was formed as a sulphide replacement of a quartz sericite schist. It closely follows the strike and dip of the country rock. The sulphide mass is localized along a fault which follows the axial plane of a dragfold. This dragfold lies on the limb of, and has a similar attitude to the major syncline whose nose is located to the west some two miles. The Geco deposit is found in a zone of quartz sericite schist that is bounded on the north by granite and on the south by gneisses.

The ore zone at Geco is about 2,700 feet long in an east-west direction, and is up to 220 feet wide. The average width is about 75 feet. It is mineralized with chalcopyrite, sphalerite, pyrrhotite and pyrite. The tex-

The operation features gravity ore transfer to a conveyor and a friction hoist

Tramming . . . . . These Are The Results

ture of the ore in the deposit ranges from massive to disseminated sulphides. A band of massive sulphides is found near the southern contact of the vein with the gneiss and this band occupies about ¼ to ⅔ the width of the vein. Dips are steep but the shoot rakes to the east at an average angle of 32°. The Geco structure is cut by several transverse dikes and at least one major fault. These divide the ore shoot into three blocks for the purpose of mine development. The A block extends from the western extremity to the Fox Creek fault. At the surface this block is about 1,200 feet long and it represents the portion of Geco's orebody which is now being stoped. The B block is offset about 250 feet north of the A block. It is 850 feet long at the surface and averages 85 feet in width. The B block extends from the Fox Creek fault on the west to the diabase dike system just east of the No. 1 shaft. The C block is east of the diabase dike and has a length of 600 feet near the surface with a nearly vertical dip. The C zone is relatively unexplored, and possibilities

Drilling on 50′ Stope Width Layout

Feet per drill shift	130′
Feet per sill ring	137 & 161
Feet per sub-level ring	560 to 570

Blasting

Pounds of powder per 10 cubic feet of ground in undercut	0.70
Pounds of powder per 10 cubic feet in slot	0.98
Pounds of powder per 10 cubic feet in drill rings	0.29
Average pounds of powder per 10 cubic feet in stope work	0.34
Average pounds of powder per 10 cubic feet in pillars	0.28

Production

Tons per foot of blast hole in slot	1.0
Tons per foot of blast hole in undercut	1.6
Tons per foot of blast hole in drill rings (stopes)	3.2
Average tons per foot of blast hole in stope work	2.5
Average tons per foot of blast hole rings (pillars)	4.5
Average tons handled per slusher shift	300
Tons per contract drill shift	325
Average tons per underground manshift	25
Feet of development per ton of ore, including pillar recovery	.01
Average total tonnage recovered per stope	150,000 to 175,000 tons

Conveyor Installation (Type: Meco troughing idlers on 3-foot centers return idlers on 12-foot centers, Goodyear 5-ply, 42-inch belt; total length of conveyor 1,095 feet)

Total ore handled to end of 1958 (tons)	1,631,762
Cost of installation per foot (includes equipment and labour, but excludes cost of conveyor drift)	$67.00
Operating cost per ton of ore handled (underground crushing and conveying)	$0.102

for finding additional ore at depth to the east of this area are good because of the known rake of the deposit.

Ore reserves figures released by the company at the end of the 1958 total about 16,011,000 tons of 1.76 percent copper, 3.75 percent zinc, and 1.75 ounces of silver per ton. Of this total, 4,390,000 tons are contained in the A zone, 7,693,000 tons in the B zone, and 3,928,000 tons in the C zone. The A zone contains copper and zinc in roughly equal amounts with perhaps a slightly higher proportion of copper. In the B zone near the surface, the zinc ratio is higher. With depth this zone changes, from low copper-high zinc to high copper-low zinc. Total B zone ore developed to the 1,250 level averages 1.57 percent copper and 4.07 percent zinc. Known C zone ore is high in zinc and reserves in this portion average 2.07 copper and 4.97 percent zinc.

Level Development

Operations were planned for sub-level mining in 50-foot-wide stopes normal to the strike of the ore shoot. A master development pattern was outlined which would permit recovery of ore in both the A and B zones. The basic essentials of this pattern consisted of the following:

(1) A vertical production shaft which was collared in granitic rock north of the ore structure and at a point along the strike between the B and C ore zones; it was sunk to a depth of 1,486 feet; (2) six main levels driven at 200-foot vertical intervals from the No. 1 production shaft (the first level is actually 250 feet below the collar); (3) a 55° ore pass driven up the approximate rake of the western fringe of the ore and which linked the lowest mine level (1,250) with the 50 level; (4) branching transfer raises driven from the ore pass to the stope blocks; (5) a 1,600-ton pocket at the bottom of the ore pass which feeds a crusher on the 1,250 level; and (6) a conveyor system leading from the crusher to the shaft pocket on the 1,250 level.

While this basic level development was underway, the No. 2 shaft was sunk in a pillar near the center of the A zone to a depth of 550 feet. Adits were driven to the ore on the 50 level and on the A1 sub level. This early upper development facilitated early preparation of a few stope blocks in the western portion of the A zone above the valley floor. Stope preparation in ore permitted the accumulation of an ore stockpile pending completion of the mill and basic mine level development. It also insured adequate stope development to keep the mill going at capacity after it was completed and until level development was enough advanced to insure regular production through No. 1 shaft. The No. 2 shaft is now used for service and ventilation purposes only.

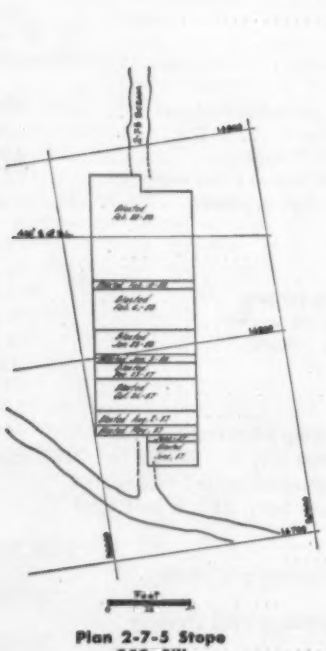
The main levels are tracked with 30-pound rail and measure 9 by 8 feet in cross section. In general, each heading is driven using three Atlas Copco airleg drills and a shop-made service car with a hinged and folding, flat, timber bed. The service car contains air and water connections, is loaded with steel, bits and tools, and also serves as a drill platform for holes near the back. The drift rounds are drilled with a total of about 36 holes. A 2⅛-inch tungsten carbide reaming bit is used on the cut holes. These rounds are mucked with an Eimco 21 Rockershovel, and the waste is trammed to the shaft by Mancha locomotives hauling Granby and rocker dump cars. Loading pockets were installed at each shaft station to handle development waste. All ore now broken from stopes gravitates to the 1,250 level where it is crushed and conveyed to the shaft.

Stope Blocks

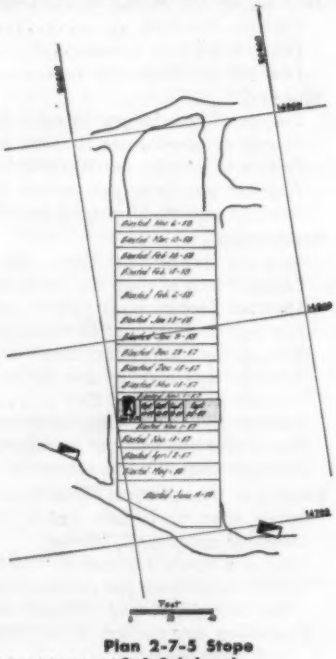
The stope areas are outlined (see 250 level plan) by a service drift in waste on the north and a ventilation drift driven along the fringe of the ore on the south. Scram drifts extend between the service and ventilation drifts. They are driven on 100-foot centers along the center axis of the stope blocks. Alternate stope blocks are mined to completion, leaving 50-foot-wide pillars of ore between finished stopes. The pillars are recovered on the retreat by sub level blast-hole methods.

All of the upper stope blocks were based on a stope height of 300 feet with one sub level 100 feet above the sill. Experience has since indicated that a 460-foot stope height in 70-foot-wide blocks would be the most economical pattern. The sub level then

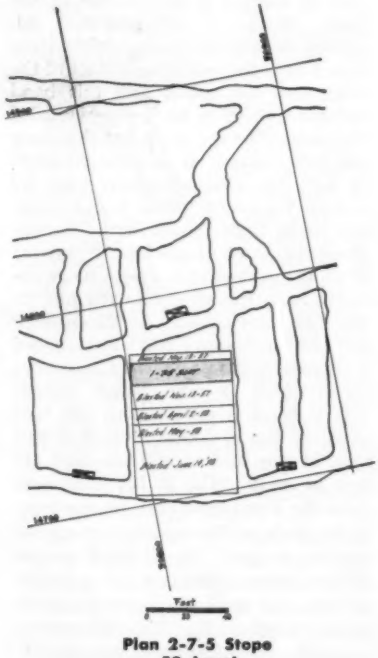
Stope details are illustrated on third and opposite page



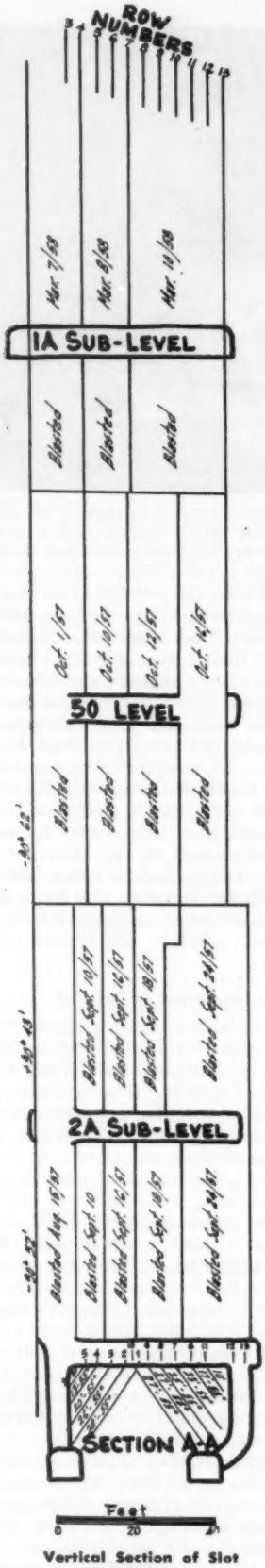
Plan 2-7-5 Stope 250 Sill



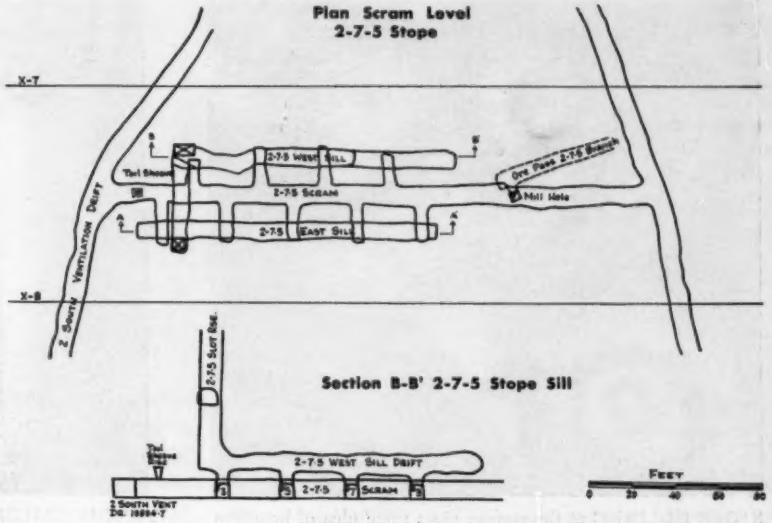
Plan 2-7-5 Stope 2-A Sub level

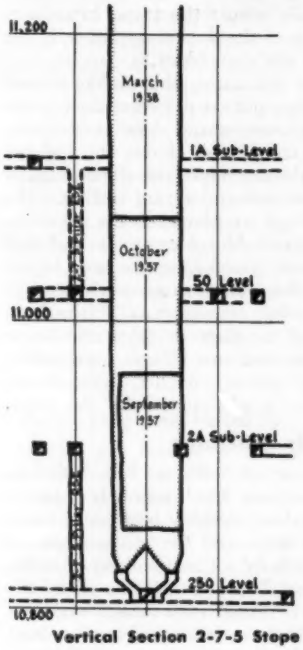


Plan 2-7-5 Stope 50 Level

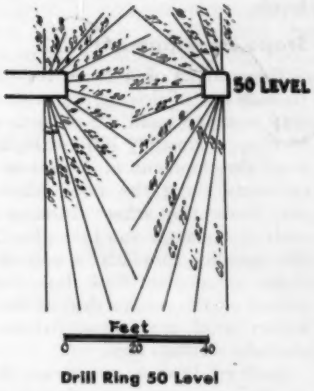


Vertical Section of Slot
2-7-5 Stope

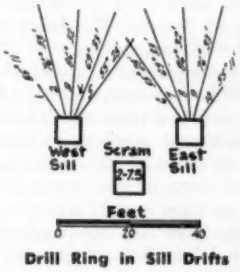




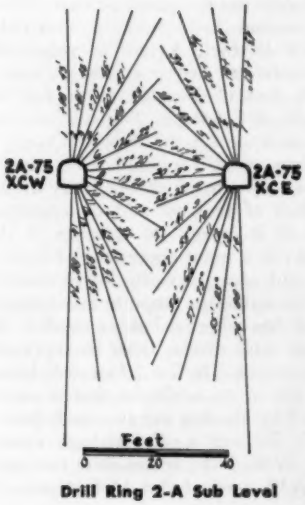
Vertical Section 2-7-5 Stope



Drill Ring 50 Level



Drill Ring in Sill Drifts



Drill Ring 2-A Sub Level

STOPE HOLDING at the surface gives some idea of how firm the wall rock is. This is a 1-4 stope and the 1A and 1B drilling subs are visible in the photo.

TYPICAL SLUSHER installation in scram shows a Joy electric unit which powers an Eimco 72-inch folding scraper. Average index for slushing efficiency: 200 tons per slusher manshift.

would be driven about 100 feet above the sill. These latter dimensions will probably be utilized on future blocks developed between the 1,050 and 450 levels.

Stope Development

Preparation of a stope for mining consists first of driving an access manway in an adjacent ore pillar to a sub level approximately 100 feet high. Sub level development of a pair of drill crosscuts along the stope block line and connecting fringe drifts at both ends of the stope can take place from this opening. Similarly, a pair of drill drifts along the block line can be turned off the service drift of the next higher level and connected on the south by a fringe drift.

Inclined boxhole raises are driven on 30-foot centers on each side of the scram drift to a height of 14 feet above the scram sill. The boxhole openings are staggered on each side of the scram to provide a drawpoint every 15 feet. A pair of stope still crosscuts are driven across the top of each line of boxhole raises for the length of the stope. The sill crosscuts are on approximate 35-foot centers.

From one sill crosscut, a slot raise is driven up the block boundary at the contact of massive and disseminated ore. It is carried to the top of the stope. At a point about 30 feet high in the slot raise, a 7- by 7-foot drift is driven across the stope to the opposite block line where it holes a small 5- by 5-foot raise driven from the opposite sill crosscut. The 7 x 7 foot drift forms the top of an undercut that is established by blasting out the ore below it while leaving a 30-foot-high crown directly over the scram drift (see sections). A vertical slot 11 feet wide is taken out across the stope above the undercut. Drilling for this is from 14′ wide slot drifts located on each sublevel and level above the undercut. The slot across the stope extends to the top of the slot raise; that is, to the top of the stope block.

The slot raise, the undercut, and the stope slot are placed at the contact of the massive and disseminated ore.

On completion of the slot and sub level development, the stope is ready for production by ring drilling. The drill rings are placed in the sill crosscuts, the sublevel crosscuts and drill crosscuts driven from the next higher level. Successive rings are blasted in series while retreating away from both sides of the stope in either massive or disseminated ore. Planned extraction during retreat on each type of ore achieves grade control for the mine.

Details of Scrams

The scram drifts are 8 by 9 feet in cross section. Each scram is holed in waste about midway between the end of the stope and the service raise on the north by a transfer raise from the ore pass. The holing in the sill of the scram is ringed with manganese steel liners that are concreted in place and which form an opening 4 feet in diameter. The floor of the scram slopes to the south away from this holing on a grade of 2½ percent. This keeps water out of the ore pass system.

Each active scram is equipped with a Joy 125-horsepower, high-slip, high-torque, electric slusher which is bolted to a permanent concrete foundation. These two drum hoists are located on the north side of the transfer raise holings, and are wound with 1¼ inch, used, wire rope on the loaded-haul side and 1-⅜-inch used rope on the haul-back side. The slushers pull 72-inch folding Eimco scrapers. In each scram the tail sheave for the hoist is hung from a shaft supported between two I-Beams that are embedded in a concrete plug in the back of the drift at the south end. Less than two men are required per scram drift. For instance, six men, including one leader, will handle the production from four scram drifts. Slushing efficiency varies depending on how slabby the ore is and how well the boxholes are running. The average is about 200 tons per slusher manshift. This figure, however, has gone as high as 800 tons per slusher manshift under ideal conditions.

How Undercut Is Drilled

The boxholes are driven by blasting three rounds. The first is a drift round 7 feet high 6′ wide, and 7 feet deep at right angles to the scram. The second and third are raise rounds 5-by 5 feet in cross section, driven at a 45° angle from the top inside corner of the sill round to the sill crosscut level.

The undercut for the slot is established by drilling a minimum of 10 and a maximum of 13 rows of holes across the bottom of the slot drift about 30 feet above the sill crosscut level. The holes are spaced 3 feet apart, measured across this drift, and on 3.5 foot centers along the drift. The first set of 3 or 4 holes is placed across the slot drift midway between the stope boundaries; this row is angled downward at 55° towards the slot raise on the west. The second set is positioned in a row 3.5 feet from the first and angled downward at 55° toward the slot raise. Five rows are drilled on the west half of the slot

drift, and this same pattern is repeated on the east half by angling the holes at 55° downward towards the opposite or eastern stope boundary.

The slot is taken out above the undercut by drilling 13 rows of vertical down holes and vertical up holes from a drift slashed to 14 feet wide and driven across the stope on the first sub level. These rows are spaced on 4-foot centers along the sub level and 3-foot 8-inch centers across the drift. The down holes, about 50 feet long, will break a slot to the undercut. The up holes in the slot drift on the first sub level are about 55 feet long and overlap by five feet holes drilled from a slot drift on the next higher main level.

Drill Patterns

All long holing for stope production is done on contract by Canadian Rock Co. Limited. This contract has been set up for about 30,000 feet of hole per month for a production of 100,000 tons of ore. The contractor uses Gardner-Denver SFH99, 4-inch, column-mounted percussion machines with hexagonal, Gardner Steel and 2⅛-inch tapered-socket, tungsten carbide bits.

Standard drilling and loading patterns are used for all stope blast hole work. Drill rings covering 70° of arc are put in over the top of the east and west sill drifts of each stope. This pattern leaves an approximate 30-foot pillar over the top of the scram drift. The undercut sill rings are spaced on 4-foot centers with 5 holes to every set and 6 holes in the alternate set. The foregoing rings require a total of 137 and 161 feet of drilling respectively.

In the east and west sub level crosscuts along each side of the stope, the first drill ring is placed about 4 feet behind the slot. All subsequent sub level rings are then put in on 8-foot centers along the two headings. Within each ring the burden on the toe of the holes is about 9 feet. Sub level drill rings require between 560 and 570 feet of drilling per ring.

The overall yield of ore broken per foot of blast hole in stopes is 2.5 tons. This figure is broken down as follows: the slots produce one-ton-per-foot of blast hole; the undercuts produce 1.6 tons, and the sub level rings 3.2 tons-per-foot of hole. While blast holes in the slot are overlapped 5 feet, the rings drilled from adjacent headings during normal production work overlap a minimum of 3 feet.

For blasting purposes, 1¾-inch by 16 inch cartridges of 75 percent Dygel are used. Some hole caving has been experienced, particularly at the intersection of ore and diabase dikes. In this situation 1½-by 16-inch cartridges have been used. The overall powder factor is about 0.33 pounds per ton of ore. For blasting purposes, the ore in place is calculated at 10.6 cubic feet per ton. In the standard hole loading patterns used at the mine, the undercut holes are charged with 0.7 pounds of powder per 10 cubic feet of ground at the toes of the holes. The vertical holes in the slots are loaded with 0.9 to 1.0 pounds of powder per 10 cubic feet. This latter figure may seem unduly high and is actually more than required to effectively break the slot. It is caused by the fact that 4 rows of holes are placed across an 11-foot-wide slot to counteract the effect of hole wandering. The holes in the sub level drill rings are loaded with 0.3 pounds of blasting agent per 10 cubic feet of ore at the toes of the holes. This latter charge is concentrated near the bottom of each hole.

DETAILS OF tail sheave serving slusher set-ups in active scrams are shown in this photograph. These permanent mountings have provided trouble-free operation.

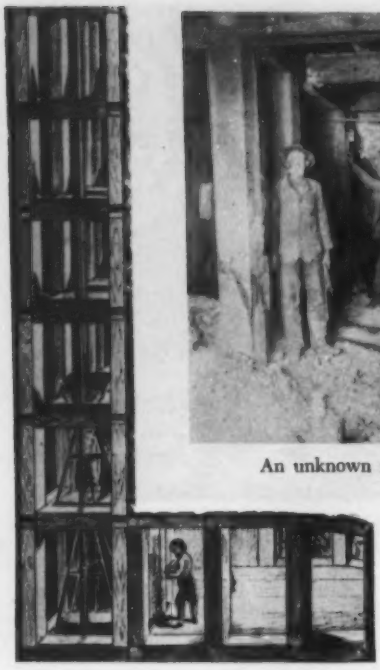
Conveying and Hoisting

The ore broken in the stopes is scraped to the transfer raises which branch out from the 6 by 10-foot ore pass. From the 1,600 ton pocket at the bottom of the ore pass, it is fed to a 44-by 60-inch Allis Chalmers jaw crusher with a capacity of approximately 400 tons-per-hour. A short belt conveyor delivers the crushed rock to a Jeffrey feeder, which cushions the rock impact on the main conveyor on the 1,250 level. This latter conveyor is a Meco installation and measures over 1095 feet center to center of drive and head pulleys. It is equipped with a 42-inch Goodyear belt. The main conveyor transfers the ore to a 600-ton pocket at the No. 1 production shaft. The shaft pocket is equipped with two Bin-Dicators to shut off the belts when the pocket is full. The company has plans to install another crusher station about midway between the shaft and the present crusher location to handle the B ore from the 1,250 level.

The No. 1 shaft measures 7-feet 10 inches by 34 feet 2 inches outside dimensions. It has one cage compartment, one skip compartment, two counterweight compartments, and a manway containing air, water, and ventilation piping. The shaft is equipped with two friction hoists. Both are four rope systems. The smaller of the two is a Canadian Ingersoll Rand hoist powered by a 500-horsepower Canadian General Electric D.C. motor. Four 1-inch ropes travel over an 8-foot-diameter sheave, and this unit hoists the 40-man cage at 1,500 feet per minute. It is capable of handling a total load of 14,000 pounds. The larger hoist is also made by Canadian Ingersoll Rand and it features two motors in tandem, a 900-horsepower and a 1,250-horsepower Canadian General Electric wound rotor induction motor drive. This hoist has a 10-foot, 10-inch-diameter sheave and four 1⅛-inch ropes. Both hoists are counterbalanced. The skip hoist has 4-1⅛" tail ropes and the cage hoist has 2-1½" tailropes. The larger hoist suspends an 18-ton Dorr-Oliver-Long skip, and the capacity of the system is approximately 21 skips per hour (400 tons).

The hoists are installed in a 39-foot-high housing on top of a 183-foot concrete headframe which contains a 2,000-ton bin and crushing facilities.

Geco's mine, though only in production a little over a year, has already rung up an impressive record for production efficiency. It brings employment to over 500 people in the Manitouwadge area which has now been transformed from wilderness to a modern town site. THE END



An unknown mine

At height of boom Virginia City looked like this

Virginia City Celebrates Discovery of the Fabulous, Silver-Rich Comstock Lode . . .

Where Modern Square Set Mining Was

Eyes of the mining world will be focused on Virginia City, Nevada June 12-13-14 when Nevada observes its Silver Centennial with a rousing three-day celebration commemorating discovery of silver on the fabled Comstock Lode.

For it was on June 8, 1859, that what was to become known as the Comstock Lode was discovered by Patrick McLaughlin and Peter O'Riley, Irish prospectors.

Its discovery was to play an important part in national and international affairs; its production was to alter world monetary standards; it was to mean statehood for Nevada; its discovery accelerated development of the American West; and, most importantly, it proved that there were other major mineral resources to be sought other than California's earlier placer gold.

The Comstock lode was the birthplace of major mining and metallurgical achievements, many of which still play important roles in mineral production. Most famous of these developments, and one which has been, and is still used in all parts of the world, is square set stoping.

Silver was first discovered by McLaughlin and O'Riley washing for gold on Sun Peak near the head of the present Gold Canyon. Their discovery was quickly shared by James (Old Virginia) Fennimore, who gave Virginia City its name, and Henry T. P. Comstock, vociferous and indolent, for whom the Comstock Lode was named.

The rich silver ore, running as high as $3,500 a ton, started a boom in the mountainous western Nevada area—a boom which saw ultimate production valued well over a half a billion dollars and some of the richest ore ever uncovered on the face of the globe.

One "Rush to Washoe" followed another for a period of 20 years after discovery of the Lode and the mass migration of fortune seekers made Virginia City the greatest mining camp in the world—the "Queen of the Comstock". During the height of activity, close to 30 mines were operating full blast in the area.

As a result of the great discovery, history was written—history that was to tell of great engineering and mining feats; history that was to find its way into legal books and documents the world over. Some of the nation's basic mining laws were written because of this great discovery and the interminable litigation which followed.

In early days of locating mining claims, no attention was given to having claims of a certain size. Claims of all sizes consequently were located without regard to end or side lines.

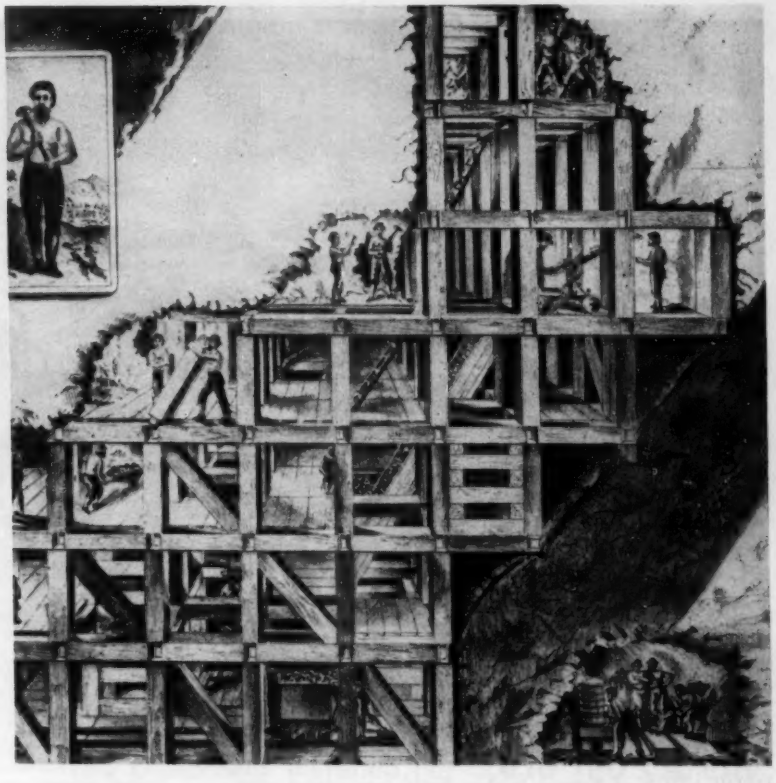
Such a condition led to burdensome litigation and the eventual outcome was some of the nation's basic mining laws, formulated for the most part by William M. Stewart, counsel for the principal mining companies and later Nevada's first United States senator.

Square Sets Save Mines

As the miners followed the vein into the earth, it widened rapidly. At the Ophir Mining Company, it was four feet wide on the 50-foot level and at 175 feet it had widened to 65 feet. The ore was so soft that no supporting pillars could be left, there was no timber long enough to extend from wall to wall so several pieces were spliced together in a futile attempt to hold the hanging wall. Thus surrounded by the highest grade ore, miners at the Ophir spent most of their time escaping caves rather than mining. The situation grew critical as all attempts to produce the riches failed.

It was in the fall of 1860 that a young mining engineer of German descent, Philip Deidesheimer, operator of a gold quartz mine at Georgetown, California, was urgently summoned to Virginia City by the Ophir Company. He carried with him a letter authorizing him to inspect the mine and determine, if possible, a way of timbering. It took him only a few weeks to develop the first square sets

Early tools of the trade



Developed

and their use rapidly extended to all mines on the lode. Timbering was no longer a problem. His experience in California mines had yielded a clue to timbering the Comstock. He was a most successful mine operator, but lost all his money in the panic of 1874 when company stocks dropped on the mining exchange.

Bonanzas At Hanging Wall Spurs

According to Roy A. Hardy of Reno, a prominent Nevada mining engineer and chairman of the Nevada Silver Centennial Committee, "The Comstock Lode represented a contact fissure with a hanging wall of andesite and a footwall of the intrusive Mt. Davidson diorite. The vein and mineralized material is in a wide shear zone (normal fault) up to 500 feet wide, striking northerly and southerly and dipping easterly at an angle of 45° on the east side of the intrusion at the north end of the Lode. The fissure filling is vein quartz, with quartz and minerals replacing andesite wall rock having a thick clay gouge on the hanging wall, carrying silver-gold values in a ratio of about 60 percent silver and 40 percent gold in dollar value. Within the Lode, the highly fractured bonanza ore was found in lenses, generally at or near spur veins intersecting the Lode from the hanging wall. The 'Big Bonanza', the Ophir-Consolidated Virginia, had dimensions of about 1,000 feet long, 500 feet wide at its maximum width, and its top near the 1,100-foot level, thining below the 1,650-foot level. Between the various lenses, the Lode carried some values over large widths."

Hot Water, Hot Rock

As the mines grew deeper, great floods of hot water, smoke from mine fires, and rapidly increasing rock temperatures became very serious problems. Giant Cornish pumps and drain tunnels, including the too-late Sutro Tunnel, battled the water.

High temperatures were another problem. There was no question that cooling was necessary as the United States Geological Survey recorded the water temperature at the bottom of the Yellow Jacket shaft at 170° F. in 1877. On the 2,000-foot level, large sections of the rock had a uniform temperature of 130° F.

Without adequate ventilation and no mechanical refrigeration, ice was the only cooling medium available. In 1877, one company, the California Mining Company, used 1,957,402 pounds of ice. The ground was heavy as the company used 10,430,645 board feet of timber that year (over 600,000,000 had been used by all mines to that date). Fortunately, the ore was high grade and the California Company used 65 dozen brooms in that year to sweep down the stope walls and square set flooors. Production was 217,432 tons to yield $18,924,850.27 worth of bullion ($87.45 per ton).

Today, the Lode is quiet with all mining having ceased, partially due to the grade of ore and low prices of silver and gold as well as to the general unsuitable economic climate for precious metal operations.

Nevada historian-writer James Hulse of Pioche sums it up this way:

"If the big, ambitious dreams of empire are gone, many little ones remain in the Queen City of the Comstock in 1959, the Centennial year. For some time, Virginia City has been a retreat for artists and writers, who are attracted not by tales of silver and gold, but by its present day remoteness and the chance for building a secluded dominion. Perhaps there is still a lodestone quality about Mt. Davidson, working its tricks on modern artists as it did on the rugged prospectors who found the Lode just 100 years ago."

THE END

All the old-time photos were taken before the 1875 fire in Virginia City. They are from the collection of J. A. Comboi, who was an undertaker in Virginia City at the time. The photos were copied for the Nevada Silver Centennial committee for use in the MINING WORLD by Jimmie Smith of the Reno Chamber of Commerce. The photos were loaned by the Nevada Historical Society, Reno, Nevada, Mrs. Clara Beatty, director.

DEDICATION of Kermac Nuclear Fuels' new solvent extraction uranium plant took place April 16. The new mill is located in the Ambrosia Lake mining district and is said to have the largest concentrate delivery contract in existence. The new Kermac mill process company produced ore mainly, but a small amount is supplied by independent producers.

Uranium Milling

Four New Design Features at Kermac

Within one week after start up, November 28, 1959, Kermac Nuclear Fuel Corporation's 3,630-ton-per-day uranium mill at Ambrosia Lake, New Mexico was operating at capacity. The first yellow cake was drummed just 11 days later for shipment to the United States Atomic Energy Commission.

This was a tribute to the mill's design and construction. From the start, emphasis had been placed on high recovery at low cost. It is doubtful that even by doubling the $18,000,000 cost of the mill the recovery would have been raised appreciably or milling costs cut sharply.

With Kermac holding the largest domestic uranium contract, it was imperative that a large efficient mill be built to produce a maximum total of 33,000,000 pounds of yellow cake concentrate (80 to 85 percent U_3O_8) through 1963, or 6,600,000 pounds a year, and a minimum of 4,500,000 pounds annually in 1964, 1965, and 1966. This contract calls for delivery of between $300,000,000 and $350,000,000 worth of concentrate.

It was no surprise to the staff that the mill started so easily. They had spent years in perfecting the acid leach solvent extraction (both at Kerr McGee's uranium mill at Shiprock, New Mexico, and at the Golden, Colorado research laboratory), and making preliminary mill designs. They had worked closely with engineers and construction men of Stearns-Roger Manufacturing Company which did the detailed design and construction work.

Kermac has operated its Shiprock, New Mexico mill since 1954, and a pilot plant at Golden, Colorado, so it knows uranium milling.

Nothing was left to chance.

There was the big questions of drawing wet ore out of the fine ore bins. To answer the question, a small bin with new vertical bottom and a wide slow-speed belt was built at the company's Section 22 mine collar. All types of mine ore were dumped in this small bin and the feeder started. When the test was over, it was proven that this new type of bin draw-off would work. When the pilot plant indicated that a molybdenum (chloride

Operating Data

Leaching

Eight hours contact time with a pH of 0.8 in the first agitator raised to 1.0 in final agitator. Steam added to No. 1 and 2 agitators; H_2SO_4 to agitators No. 1, 2, 5, 6 and 10. 44 percent $NaClO_3$ solution added to agitators No. 3, 4, 7 and 8 to maintain EMF from 400 to 450.

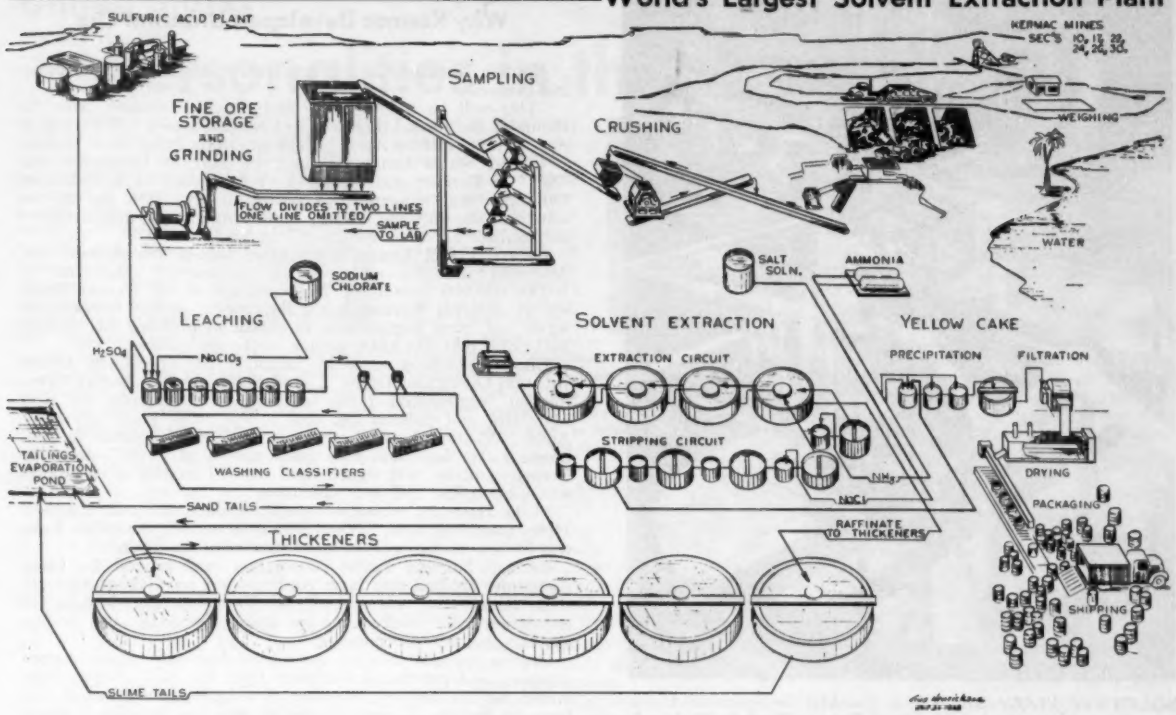
Solvent Extraction

pH of 1.2 in circuit, contact time about 200 minutes. Recycle 0 to 100 percent raffinate. Aqueous phase flows by gravity; the organic is pumped upstream.

Precipitation

Organic phase flows by gravity and aqueous is pumped upstream. Steam added to tanks No. 1 and 2. NH_3 and air added to tanks No. 1, 2, 3 and 4 for continuous precipitation. pH of No. 1 tank is 4.5; 5.5 at No. 2; 6.5 at No. 3 and 7.5 at No. 4.

World's Largest Solvent Extraction Plant



The Equipment Installed For 3,630 TPD Capacity

ORE RECEIVING

Two, 100-ton truck scales.
16, 1,000-ton concrete ore pockets.
Two, 2½-cubic-yard front-end Michigan loaders.
One, 50-ton ore pocket with 18-inch grizzly.

CRUSHING

One, 48-inch by 18.5-foot Denver apron ore feeder.
One, 42-inch by 5-foot Symons vibrating bar grizzly.
One, 25- by 40-inch Denver jaw crusher.
One, 36-inch belt conveyor with 30-inch Dings rectangular magnet.
Two, 6- by 14-foot Tyler vibrating screens with 1-inch cloths.
One, 30-inch conveyor (screen undersize to sampling plant).
Two, 30- by 42-inch Cedar Rapids impact crushers.
Two, 36-inch belt conveyors.

SAMPLING PLANT

One Geary-Jennings sampler (10 percent cut).
One, 4- by 10-foot Tyler vibrating screen with ½-inch cloth.
One Pennsylvania impact crusher.
One Geary-Jennings sampler (10 percent cut).
One set rolls, 10 by 16 inches (3/16 inch setting).
One Geary Jennings sampler.
One set rolls, 10 by 6 inches (⅛ inch setting).
One Geary-Jennings sampler (10 to 25 percent cut).

FINE ORE STORAGE

One, 30-inch belt conveyor.
One Hewitt Robins belt tripper.
Six steel storage bins total capacity 5,000 tons.
Six, 60-inch-wide Stephens Adamson belt feeders.
Two, 24-inch belt conveyors.

GRINDING AND CLASSIFICATION

(Two Identical A and B Circuits)

One Conveyoflo scale.
One, 9.5- by 12-foot, open-end Marcy rod mill.
One, 4-inch Model K Wilfley sand pump.
One, 20-inch Model D Krebs cyclone (28 mesh underflow).
One, 4-inch Model K Wilfley sand pump.
One Denver sampler.

ACID LEACHING CIRCUIT

14, 13- by 14-foot, rubber-lined leach tanks with Denver agitators.
One, 4-inch Model K Wilfley sand pump.
Two, D-20B Krebs cyclones (plus-100-mesh underflow).

SAND-SLIME SEPARATION

Five, 6- by 33-foot Dorr classifiers in series.

Sand

One Denver automatic sampler
Two, 8-inch Model K Wilfley sand pumps.
Tailing launder.

Slime

One, 6-inch Model K Wilfley acid sludge pump.
Six Eimco and six Dorr, 120-foot thickeners in CCD series.

Underflow

One Denver automatic sampler.
One, 5-inch Model K Wilfley sand pump.

Overflow

One, 60- by 20-foot Eimco reactor clarifier.
One, 6-inch Model AF Wilfley pump.
Six, U. S. Auto-Jet pressure filters.
Two, 52- by 20-foot clarifiers.
One, 6-inch Worthington CNGL pump.

SOLVENT EXTRACTION CIRCUIT

(Identical A and B Circuits)

Four, 40- by 9-foot wooden S-X mixer settler tanks.
One, 67- by 14- foot concrete A. P. I. settler.
One, 65- by 9-foot raffinate holding tank.
One, 12- by 12-foot wooden pregnant organic settler tank.

STRIPPING CIRCUIT

Four stripping units, each with an 8- by 9-foot wooden strip mixer and a 22- by 8-foot wooden strip settler.
Two, 1½-inch Galigher acid proof sump pumps.
One 20- by 20-foot wooden holding tank.

PRECIPITATION

Four, 8- by 12-foot wooden precipitation tanks in series.
One, No. 4 O. D. S. pump.

DRYING-PACKING

One, 45- by 12-foot thickener (yellow cake).
Three, 6- by 8-foot Eimco drum filters in series.
One, 8-foot Proctor-Schwartz drier.
Cleveland barrel packers.

SOLUTION FLOW METER is checked by operator James Jetensky in the stripping circuit of Kermac Nuclear Fuels solvent extraction mill near Grants, New Mexico. SX section of the mill features a molybdenum stripping circuit also.

Why Kermac Developed Uranium Ore

Kermac Nuclear Fuels Corporation is in the energy producing business.

"This will be a long-range fast-growing business" was the theme of the formal dedication of Kermac's new 3,630-ton-per-day uranium mill on April 16th at Ambrosia Lake, New Mexico.

United States Senator Robert F. Kerr of Oklahoma, the "Ker" in Kermac and chairman of the board of Kerr-McGee Oil Industries, dedicated the mill to energy. "It is the key resource of the universe, and by harnessing energy, man develops and utilizes all other resources," he said.

George Cobb, Kermac's executive vice-president, said that Ambrosia uranium reserves had an energy equivalent of 10,000,000,000 barrels of oil—one-third of all United States energy reserves. Kermac has a large share of this uranium reserve and, most importantly, the spirit to produce this energy, Mr. Cobb told the 1,000 people at the dedication.

Elton Youngberg, assistant manager for operations, Grand Junction Operations Office, United States Atomic Energy Commission, represented Jesse Johnson, AEC, director of Raw Materials, and pointed out that it was only four years ago—April 1955—that Louis Lothmann discovered uranium in Ambrosia Lake; less than two years ago—6 May 1957—that the Kermac contract was signed; and that 14 months after ground was broken, the mill was operating.

M. D. Hassialis, recently elected president of Pacific Uranium Mines Company, said, "When history is written, Ambrosia Lake will be one of the world's most significant ore bodies."

Kermac Nuclear Fuels Corporation was formed by three companies holding very large Ambrosia ore reserves who pooled these reserves for one central mill. They are: Kerr-McGee Oil Industries, Inc., Pacific Uranium Mines Company, and Anderson Development Corporation.

Ore for the new mill has come from Kermac's mines, custom shippers, and purchased stockpiles from the AEC. Kermac has mined out its Section 10 mine, is shipping development ore from its Section 22 and 30 mines, and has completed shafts preparatory to drift development at its Sections 17, 24, and 30 mines.

stripping) circuit on raffinate was necessary, such a circuit was included in the new mill.

An early decision was made to save $0.25 per ton by not drying the mill feed, much of which was known to be wet. Accordingly, 100 percent excess capacity was built into secondary crushing plant—hammer mills, belt conveyors, and vibrating screens—to handle the wet ore. By using stainless steel chutes, polyvinyl chloride chute lining, and electric vibrators, hang ups and spill at transfer points have been almost non-existent, despite 1,000-ton mill lots containing as much as 15 percent water.

Kermac engineers determined that it would be cheaper to make sulphuric acid for leaching than to buy it. Accordingly, the world's largest contact type acid plant using molten sulphur was built at the mill site under contract by Western Knapp Engineering Company. The plant uses 400 tons per day of molten sulphur, trucked in from west Texas oil refineries treating sour crude, to produce 450 tons of sulphuric acid daily. Excess acid not used by Kermac is sold to uranium mills as far away as Moab, Utah.

Continuous regeneration of organic solvent is necessary to remove the molybdenum which "poisons" the solvent and cut down its uranium loading capacity. This solvent is a mixture of 95 percent kerosine as a carrier, 2.5 percent of General Mills Tri-Fatty amine, and 2.5 percent isodecanol. The barren organic from the uranium stripping circuit passes through a mixer tank to which steam and ammonium hydroxide are added. The molybdenum transfers to the aqueous phase from the organic. The aqueous solution is stripped off and presently discarded. Research is underway to determine the most profitable form in which to recover the molybdenum.

This is a solvent extraction circuit within the main uranium solvent extraction circuit. THE END

These are the men who run the Kermac operation

BOLTON
General Manager

CARLSON
Mill Superintendent

WOODY
Chief Metallurgist

KIEL
Maintenance Superintendent

United States

Personalities in the News——

ERSKINE A. MASSEY, since 1954 assistant superintendent of International Minerals & Chemical Corporation's phosphate mines at Bartow, Florida, has been transferred to that company's mining and exploration department as a mining engineer, with headquarters in Skokie, Illinois. Mr. Massey, a graduate of the University of Alabama, was with Tennessee Coal and Iron Division of U. S. Steel before joining International Minerals & Chemicals in 1953.

ALLEN D. GRAY has been named president of Fremont Minerals, Inc. and Mines Development Company, subsidiaries of the Susquehanna Corporation. Mr. Gray has served both firms since their founding as general manager and later, executive vice president. Mines Development Company operates a custom uranium mill at Edgemont, South Dakota, while Fremont Minerals operates a similar mill in Wyoming's Gas Hills District. Mr. Gray will continue to make his headquarters in Denver.

WILLIAM H. LOVE has been named general manager of Hecla Mining Company, Kellogg, Idaho. Mr. Love, who has been with Hecla since 1948, has served Hecla as superintendent of exploration at the Atlas project near Mullan, Idaho; as superintendent of the Radon uranium mine at Moab, Utah; and as manager of mines in the Coeur d'Alenes. As general manager, Mr. Love will be in charge of all Hecla Mining Company operations in Idaho and Utah.

Harve I. Ashby, an employee of Kermac Nuclear Fuels Corporation since 1956, has been appointed to the newly created post of general superintendent for Kermac's operations in New Mexico.

Lester S. Harrison, a mining attorney and mining company executive of Kellogg, Idaho, has been named chairman of the board of the new Radorock Resources, Inc., formed by a merger of Radorock Resources of Salt Lake City and the Chesapeake and Colorado Corporation of New York.

Bernard Jones, a St. Joseph Lead Company employee at Bonne Terre, Missouri, was recently honored by the Missouri House of Representatives for what it termed an act of unusual bravery in a lead mine accident at Viburnum, Missouri. Mr. Jones volunteered to descend into a shaft to reach four fellow workers who had fallen 200 feet to the bottom.

Oliver Iron Mining Division of United States Steel Corporation recently announced the closing of its Canisteo District office at Coleraine, Minnesota. Operation of mines in that area will be conducted from the Hibbing District office under general superintendent **John H. Hearding. Marvin C. Johnson,** former assistant general superintendent of the Canisteo District, has been appointed assistant general superintendent of the enlarged Hibbing District. **Edwin A. Friedman** will serve as superintendent of western mines formerly in the Canisteo District, and **Norman Helland** will serve as superintendent of mines formerly in the original Hibbing District. In other changes, **David E. Hill,** former assistant chief engineer in the Canisteo District, has been transferred to the same position in the Eastern District.

Don Ellery has been named manager of the newly formed maintenance and construction division of Kermac Nuclear Fuels Corporation's New Mexico operation. Mr. Ellery previously was project superintendent for Stearns-Rogers Manufacturing Company on the construction of Kermac's uranium mill. **T. C. Onstott** has been named mine maintenance superintendent at Kermac, and **Roy Banks** has assumed the position of mill maintenance superintendent.

Albert C. Prisk recently retired as superintendent of maintenance for Oliver Iron Mining Division's Canisteo District operations. Mr. Prisk completed 49 years of service to the United States Steel Corporation, primarily in the Ely District of Oliver Iron Mining Division.

Sherman Westgard, superintendent of copper refineries of the Great Falls, Montana, Reduction Department of The Anaconda Company, has been appointed superintendent of copper refineries, Raritan Copper Works, International Smelting and Refining Company, Perth Amboy, New Jersey. International is a wholly owned Anaconda subsidiary. Mr. Westgard has been associated with The Anaconda Company since 1938.

Carl S. Gommel, manager of the Garfield cobalt refinery of Calera Mining Company, wholly owned subsidiary of Howe Sound Company, has been transferred to Henderson, North Carolina, where he will build a pilot plant for extraction of silver values from tungsten concentrate. **Howard L. Richards,** a graduate of the University of Utah, has been named manager of the refinery at Garfield, Utah.

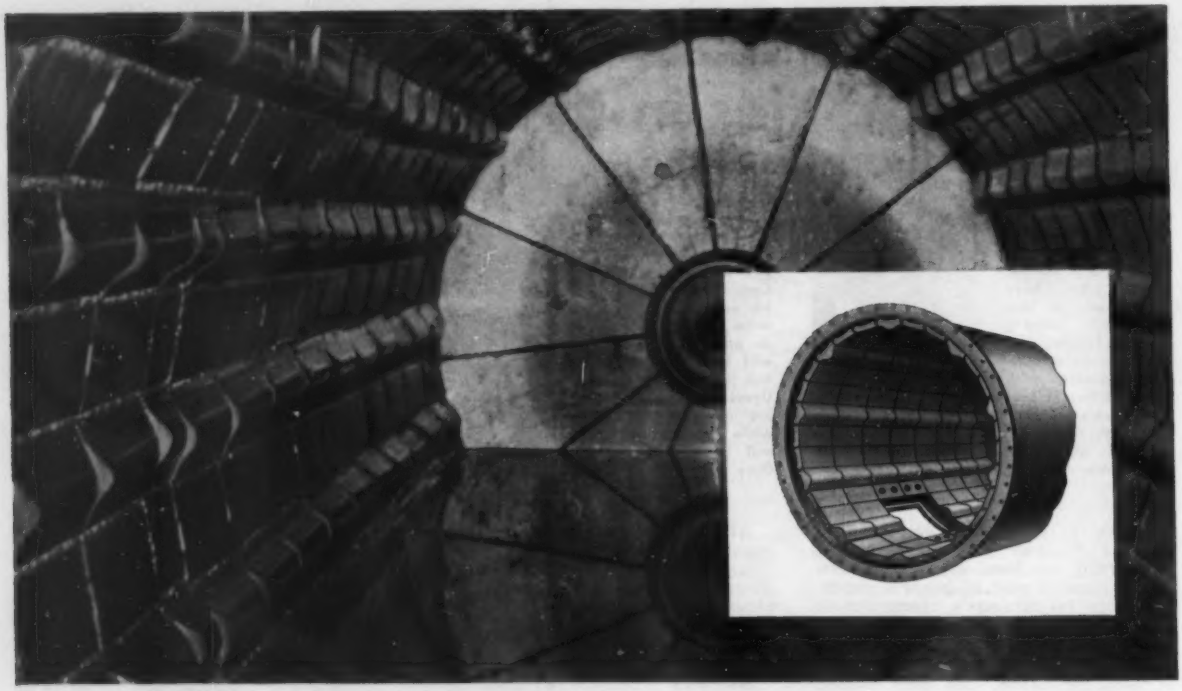
The board of directors of American Smelting & Refining Company recently elected ROBERT D. BRADFORD (left), and EDWARD MCL. TITTMANN (right) as executive vice presidents. Mr. Bradford, who has been a vice president since 1952, and a director since 1957, began with ASARCO as a junior metallurgist in 1926. Since that time he has served in the Western Department at Salt Lake City, Utah and in New York City headquarters. He is presently president of Lake Asbestos of Quebec, Ltd., ASARCO's asbestos producing subsidiary, and is in charge of the company's Federated Metals Division, a producer of secondary metals. Mr. Tittmann joined ASARCO as a chemist in Salt Lake City. In December 1958 he was named vice president in charge of smelting and refining operations, prior to which he served as president of the Southern Peru Copper Corporation for three years.

Dr. M. D. Hassialis, head of The Columbia University School of Mines, New York, was elected president of Pacific Uranium Mines Company. Dr. Hassialis, an international authority in mineral engineering and uranium processing, is also director of the Columbia University beneficiation laboratory, operated for the Atomic Energy Commission. He was a member of the United States delegations to the last two Geneva Conferences.

Lockwood W. Ferris, president of Bonneville, Limited, Salt Lake City, Utah, was elected president of the Utah Mining Association. He succeeds **Charles A. Steen** of Moab, president of Utex Exploration Company. **Oscar A. Glaeser,** general manager of Western operations, United States Smelting Refining & Mining Company, Salt Lake City, was elected first vice president and **S. K. Droubay,** general manager of United Park City Mines Company, Salt Lake City, was elected second vice president. Reelected officers were: **A. G. Mackenzie,** vice president and consultant; **Miles P. Romney,** secretary-manager; and **Walter M. Horne,** assistant secretary-manager.

George C. Watts, superintendent of the Embarrass Mine, of Pickands Mather & Company at Biwabik, Minnesota, retired recently after 35 years of service with the company. Mr. Watts joined Pickands Mather in 1924 as a mining engineer helper. Since that time he has served in the Hibbing District as a mining engineer at several mines, and he was appointed superintendent of the Preliminary Taconite Plant for Erie Mining Company near Aurora in 1947. Following seven years of development work on taconite, Mr. Watts became superintendent of the Embarrass Mine at Biwabik.

James E. Petersen, director of industrial relations for the Ray Mines Division, Kennecott Copper Corporation, Ray, Arizona, has been named director of industrial relations for the Utah Copper Division of Kennecott. He succeeds **Maurice Strittmatter** who resigned recently to return to engineering work.



8 Reasons Why You Should Standardize with B&W Universal Liner Plates

Better Performance with Lower Costs— Same Casting Fits All Mill Sizes

B&W Tube Mill Liners reduce capital, time and labor costs. Consequently, they reduce the cost of the material ground. Here are eight reasons why:

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4. Reduced Costs in Both Direct Labor and Outage —installation time is less because small size and weight of castings allows them to be handled easily, without cranes and with less fatigue for workers.
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6. Reduced Costs in Liner Inventory—standardization is possible because one design fits all diameters of mills. Standardization means quicker unloading and storage.
7. Reduced Costs on Breakage Claims and Delays for Replacements—small castings are rugged and almost impossible to break by handling. Large castings of hard, brittle irons sometimes break in shipment.
8. Reduced Costs in Determining Most Efficient Wear Patterns—you can get wear profiles consisting of all lifter ribs or all flats from the same castings, as well as a combination of both including straight or spiralled lifter pattern.

Liners are supplied in two nominal thicknesses, 1½″ and 3″ with 1½″ high lifters. Castings are 6″ wide x 12″ long. Positive seating of small castings on mill shell means less breakage of castings under operating conditions. For additional information on B&W Universal Tube Mill Liner Plates write The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

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S-471

Newsmakers in International Mining

These two mining men are visiting mines and refineries in different parts of the world. JAMES NORRIE, left, consulting mining engineer for the Rhodesian Selection Mine Services at Kalulushi, Northern Rhodesia, will be visiting mines in Michigan and Colorado in the U. S., and in Mexico during June and July. J. VARLEY (right), manager of the British Insulated and Callender Cables Copper Refinery in England, has been inspecting Ndola Copper Refineries, Ltd., and the copper refinery at Mufulira Copper Mines, Ltd., in Northern Rhodesia.

Dr. Eugene Callaghan is in Belo Horizonte, Brazil working in the St. John d'el Rey mining properties for the M. A. Hanna Company. He has been there for about a year and will probably remain for another year.

W. A. Green has been elected to the new position of executive vice president of Hudson Bay Mining and Smelting Company, Ltd., Canada. Mr. Green has been a vice president and director of Hudson Bay since 1956 and has served the company as general superintendent and general manager.

M. H. Bonner, formerly associated with Eastern Mining and Metals Company, Ltd. in Malaya, is now with Scott & English (N.E.A.) Ltd. in Tokyo, Japan.

Jose Marino Olondriz has been elected president of the Consolidated Mines, Inc. in the Philippine Islands. Mr. Olondriz succeeds his father the late **Jose Marino Olondriz, Sr. Fermin Z. Caram, Jr.** has been elected vice president and secretary; and **Eligio S. Garcia** is treasurer and assistant secretary. Other members of the board which were elected at the annual meeting of the board are: **Claudio Teehankee, Perfecto G. Mendoza,** and **Simon R. Paterno.**

Frank F. Russell, chairman of the board of Cerro de Pasco Corporation, was recently elected president of the Peruvian-American Association, Inc., succeeding **R. F. Goodwin**, chairman of the executive committee of Southern Peru Copper Corporation. Mr. Russell previously served as a vice president of the Association.

A. A. von Maltitz has been appointed managing director of Anglo-Transvaal Consolidated Investment Company, Ltd., Union of South Africa, and a member of the Gold Producers' Committee of the Transvaal and Orange Free State Chamber of Mines of which he was previously technical director. He will succeed **B. L. Bernstein** at Anglo-Transvaal Consolidated Investment Company. He has held various positions in the gold, diamond, and copper mines of South Africa and Northern Rhodesia, and in the Government Mining Engineer's office of the Department of Mines. Before joining the Anglo-Transvaal group, he was a consulting engineer of the New Consolidated Gold Fields group in Johannesburg, South Africa.

S. E. Lavrov has joined Marsman and Company, Philippine Islands, as assistant to the president and mines manager. Mr. Lavrov has many years of experience as a consulting mining engineer and civil engineer in the Far East. Proir to joining Marsman, he worked as a contractor of the Tai Lam Chung water tunnels in Hong Kong, and before World War II he was in charge of the mining operations of Marsman Hong Kong China, Ltd.

Biswa Man Pradhan and **Yogendra Lall Singh**, both of Kathmandu, are currently studying for advanced degrees in geology at the University of New Mexico in the United States. Mr. Pradhan and Mr. Singh are graduates of the University of Patna in Nepal.

W. T. Swensen and **Cam Cheriton**, Anaconda Company geologists from Toronto, Ontario, Canada, and **James Kelley** of the Anaconda Company's Southwest Exploration Office at Tucson, Arizona, United States, were recent visitors at the Ray Mines Division, Kennecott Copper Corporation, Ray, Arizona. While at Ray Mines they toured the Ray Pit.

Jesus S. Cabarrus, president of Marinduque Iron Mines, Acoje Mining Company, and C.O.R. Minerals, Philippine Islands, was elected president of the Base Metals Association of the Philippines for the 1959 term. Other directors re-elected were **Manuel Elizalde, O. A. Boni, Andres Soriano, Jr., C. M. Smith** and **M. R. Arick.** New directors elected at the meeting were **Jose Marino Olondriz, Fermin Z. Caram, Jr.** and **Henry A. Brimo.**

MARCEL LECOMPTE, (center) International Nickel Company miner, shows the citation and Medal for Bravery awarded to him recently by the Canadian Institute of Mining and Metallurgy to Nick Duda (right), the man whose life he saved in a dramatic incident at INCO's Levack mine, in the Sudbury District, of Ontario, Canada, last year. While Lecompte and his partner, Mr. Duda, were lighting and loading a round of holes in the mine, one shot of the blast fired, knocking Duda unconscious. Knocked down by the blast, Lecompte recovered in time to carry Duda to safety seconds before the blast from the other 25 burning fuses went off.

HAROLD WEDGWOOD (left), assistant manager, and MAX GOLDICK (right), concentrator superintendent, of Roan Antelope Copper Mines at Luanshya, Northern Rhodesia, have been inspecting mining and concentrating operations in Montana, Utah, and Arizona in the United States, and in northeastern Canada during May and June.

J. J. Sibley of Santiago, Chile has joined in the formation of the new Canadian firm of MacDonald, Sexsmith & Sibley. The new company follows a working association over a period of some three years between Mr. Sibley and MacDonald & Sexsmith of Toronto, Ontario, Canada. The new firm holds several properties in Chile and is planning the construction of a 500-ton plant there.

Hugh Taylor has been named production engineer at Nchanga Consolidated Copper Mines, Ltd., at Chingola, Northern Rhodesia. As such he will be responsible for the coordination of information for technical improvements at the mines. Mr. Taylor has previously been associated with Nkana and Bancroft mining companies.

John DeLeen, formerly with American Metal Climax in Toronto, Ontario, Canada, is now with Phelps Dodge Corporation of Canada, Ltd., in Vancouver, British Columbia, Canada.

John Butler has been appointed chief research officer in charge of the metallurgical laboratory of the Rhodesian Selection Trust Mines Services, at Kalulushi, Northern Rhodesia.

Philip Vince, a graduate of the Cambourne School of Mines in Cornwall, England, has been named head of the engineering department of Empresa Minero de Mantos Blancos S.A., operating near Antofagasta, Chile. Until early 1958 Mr. Vince was assistant superintendent of mines at Chuquicamata, Chile.

Recent visitors to the Rhodesian Copperbelt included the following personnel of the Falconbridge Nickel Company, Canada: **R. C. Mott**, vice president; **C. T. Mitchell**, geologist; and **P. MacRoden**, mine superintendent.

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We suggest you contact the nearest CF&I sales representative. He'll be glad to discuss your grinding problems with you, or give you complete information on all CF&I Mining Products.

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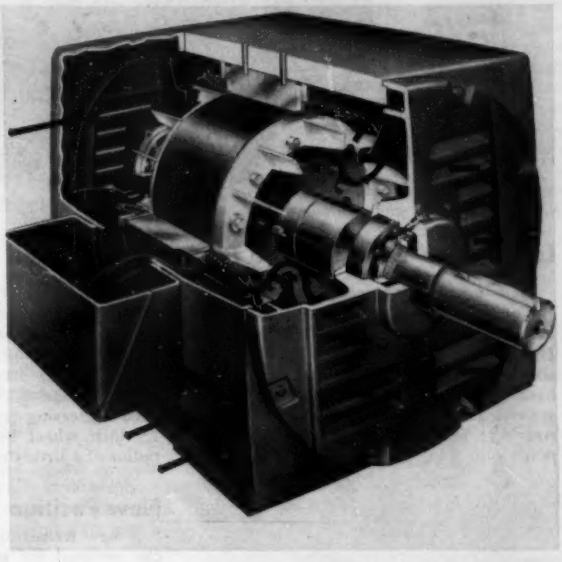
Production Equipment Preview

58 new ideas which will help your operations, including the latest in production methods, equipment, techniques, booklets and literature.

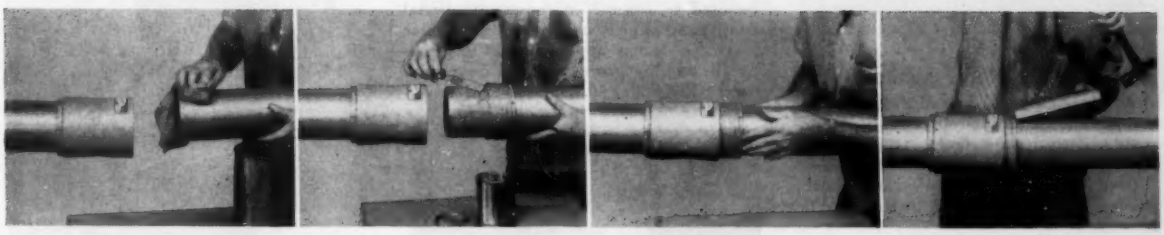
GE Motors Have New Insulation Features



General Electric Company has completely re-designed its AC motor line to provide better insulation and a square configuration in external appearance. The building block design of form-wound motors is said to make it possible to tailor the motors to meet the specific needs of a variety of industries. Open, weather-protected, and totally enclosed motors have the same general appearance but the upper enclosure, or top section, is varied to meet the user's requirements. Filters may also be added without modification to the motor. Motor size has been significantly reduced.

GE spokesmen say that perhaps the most significant new feature of the line is a Polyseal supported silicone rubber insulating system. It adds superior mechanical strength and greater resistance to adverse environments to the outstanding voltage and thermal characteristics of conventional silicone rubber insulation. Although the insulation is rated Class B, it has a Class F temperature capability and can operate successfully at temperatures up to 250° C. GE says that it is now possible for a customer to use many of the new open motors in certain damp, corrosive or abrasive atmospheres where larger, more costly totally enclosed motors were formerly required.

To provide optimum electrical design for each customized motor, GE relies upon a new computer design process. Electrical requirements are programmed on the computer which then provides a rundown of design characteristics needed. Circle No. 45.



New Corrosion Resistant Fittings Developed for Lightweight Plastic Pipe

Bondstrand, a reinforced plastic pipe developed and manufactured by Amercoat Corporation, withstands the attack of acids, alkalis and oxidized sulfides and is completely impervious to corrosion in this severe atmosphere, according to reports from the manufacturer.

With a new line of fittings, the pipe may be used for fresh water, compressed air and mine water pumping lines and for air ducts where oxidized sulfides are involved. Other uses include transport lines in plants which treat ore chemically and as pumping lines between leaching tanks, clarifiers, precipitation tanks and similar equipment. The epoxy-and-fiberglass pipe will not spark or conduct electricity and its extremely light weight simplifies handling and laying problems.

The new fittings are available for either threaded-end or plain-end Bondstrand pipe. Fittings for the latter are connected by a patented locking wedge feature pictured above. To assemble locking wedge, first clean the pipe; slide wedge over the pipe and cover with epoxy adhesive; O-ring goes on end of pipe and then insert pipe in the fitting. Drive locking wedge home with block of wood and a hammer. The plastic pipe comes in rigid 20-foot lengths in 2 to 8 inch diameters. Outside diameters exactly equal those of standard iron pipe. The specific gravity of the fiberglass and epoxy material is one-fourth that of steel pipe, so that a finished Bondstrand pipe weighs only one-eight as much as its steel equivalent. Circle No. 40.

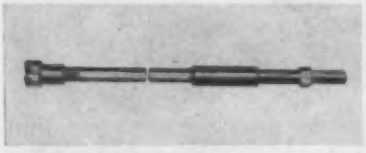
Deep Penetration Offered by Two-Plane EM Prospecting

A new aerial electromagnetic prospecting system using two planes gives better results at lower costs says AB Elektrisk of Sweden, who developed the method. Two planes are flown in tandem 400 to 1,000 feet apart. The lead plane carries automatic recording apparatus, amplifier, and tows the receiver coils in a bird at the end of a 100 foot cable. The second plane flies at the same altitude as the bird and carries the transmitter coils.

Advantages claimed for the system are its deeper penetration compared with other known electromagnetic methods. It is said to assure complete investigation of the low parts of undulating terrain. Other advantages: the depth of penetration can be controlled by varying the altitude of flight; and that the system can be flown at higher speeds and in more turbulent conditions than other methods due to the shorter towing cable. Circle No. 47.

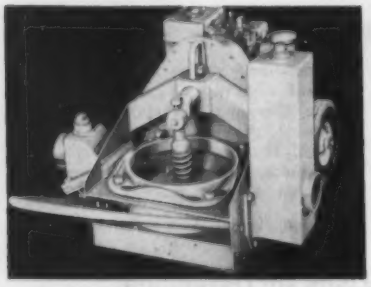
LeTourneau-Westinghouse Truck Rides On Air

New off-highway truck line made by LeTourneau-Westinghouse is claimed to have six important new features. The Haulpak trucks ride on four piston-like shock absorbers. Conventional axles have been eliminated in the Hydrair suspension system. There are no tie rods or exposed steering linkage, company spokesmen point out. The entire steering system is protected within or above the frame line giving the Haulpak almost twice the front end ground clearance of conventional trucks, according to reports. Chassis grease fittings have been eliminated in favor of sealed, lubed bearings which need regreasing only if dismantled. Short 130-inch wheel base provides a turning radius of a little over 22 feet. Circle No. 5.



Rope Thread Rods & Bits

A complete new line of rope thread, carbide bits, sectional rods, couplings and striking bars for blasthole drilling is offered by Brunner & Lay. The new Rok-Bits come in 2½, 2¾, 3, 3½, and 4-inch sizes with 1½-inch rope thread. Circle No. 49.

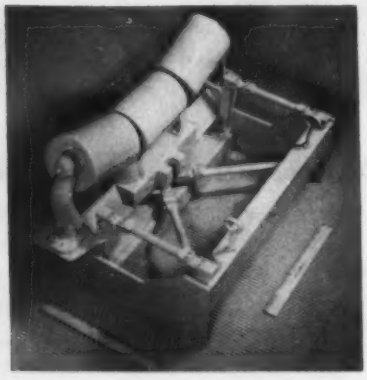


New Skid Mounted Pumps

A completely redesigned and expanded line of diaphragm pumps in the 1½ to 4-inch size range has been announced by Barnes Manufacturing Company. The new line offers capacities from 3,500 to 6,000 gallons per hour. The new pumps are designed with an integrally fabricated frame, waterbox and drive bearing supports resulting in less vibration and a lower profile. Circle No. 51.

New Position Sensing Unit

A new transistorized probe switch that can be used for sensing the position of materials has been developed by Industrial Physics and Electronics Co. The unit can be used to control equipment, to signal equipment failure, or to apply corrective measures. It has application in any material handling process around mines and mills. Circle No. 30.



New Electronic Scale For Belt Conveyor Systems

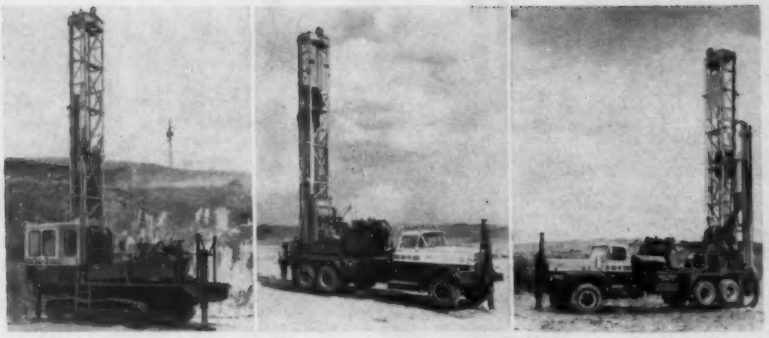
A new continuously totalizing scale utilizes an electrical transducer to convert instantaneous load weight into proportional voltages for continuous integration and digital display. The static hysteresis record is reported to be nearly perfect and the system accuracy is high. The unit is made by Bell Automation Corporation, a division of Bell Aircraft. The scale can be mounted between strands of any flat or troughed assembly. Circle No. 52.

Stripa Sink Float Process Licensed to Canadian Firm

Canadian Vickers Ltd. has been awarded North American rights to sell and manufacture Stripa sink-float plants. The process was developed in Sweden to handle a problem ore and it utilizes a bed of sized sand as a separating medium. The manufacturer states that the bed provides a greater media density. Circle No. 7.

Compression Couplings For Two-Inch Pipe

Smith-Blair, Inc. announces a complete line of new Compression Couplings for joining ½-inch through two-inch iron pipe. The couplings have high grade cast malleable iron sleeves and end nuts, and are standard equipment with wedge-type rubber gaskets. Their overall features are ease of installation and disassembly, and a maximum of flexibility. The gaskets are of beveled construction so that they draw normally and naturally around the pipe the same as in large steel or cast couplings. Compression sealing insures effectively sealing new pipe as well as older and more deteriorated pipe. Ribbed construction of the end nut surface permits a wrench to be applied at any position for tightening. For additional information circle No. 44.



New Rotary Drill Can Be Mounted On Crawler or Truck

Bucyrus Erie has developed a new medium sized rotary drill for holes 6¼ to 7⅞-inch diameter blast holes. The new unit is available on crawler mounting truck mounting or on truck mounting with power take-off from the truck engine. Down-the-hole tools are also available for all three units. Rack and pinion cable pull down is capable of exerting a force of 30,000 pounds on the bit. The bull reel can be operated mechanically from the power unit to give a maximum hoisting speed of 113 feet per minute and a maximum hoist pull of 29,500 pounds. Air for rotary drilling is supplied by a single stage. Circle No. 32.

Preview of Some New Equipment Items To Be Displayed At The Mining Machinery Exhibition in Great Britain

The Council of Underground Machinery Manufacturers in Great Britain will hold an exhibition in London, July 9 to July 18 which is epected to be the largest and most comprehensive ever held by the association. Advance notice of exhibits is limited, but we list several interesting items to be displayed.

Acrow Engineers Ltd. will display a range of hydraulic yielding props of an entirely new design which embodies principles that insure ease of maintenance at low cost. The props will demonstrate the convenience and simplicity of variation in overall minimum and maximum heights. Circle No. 62.

Consolidated Pneumatic Tool Co., Ltd. will display a new tunnel drill especially designed for high speed drifting from a feed leg mounting. The new Tornado drill is said to be capable of drilling up to 3 feet per minute in hard rock. Circle No. 63.

Mining Engineering Co., Ltd. will show a 75-horsepower, double-drum trunk conveyor drive with remote delivery, combined winch and gravity take-up, and impact idler equipped tension end. Circle No. 64.

The firm will also exhibit a new type of belt conveyor structure having idlers, the troughing angle of which vary with the load. Circle No. 65

Vulcan Sinclair Fluidrive will have a sectional model of fluid coupling units of the traction type. Circle No. 66.

Tractor Replacement Parts

A new four page brochure featuring replacement parts for most makes of tractors is announced by Columbia Steel Casting Co. Included are photos illustrating Columbia's wide range of production facilities and typical tractor replacement components made by the firm. Circle No. 4.

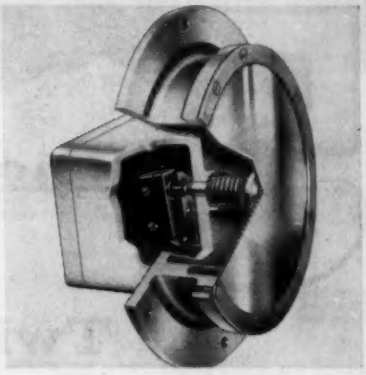
Large Hardinge Balling Drum

Here is a balling drum, believed to be the largest piece of equipment ever machined on a lathe and shipped as a single piece. The balling drum is for a sintering plant and has an inside diameter of 12 feet and is 40 feet long.

Manufactured by the Hardinge Co., the unit, when installed, will revolve about its center axis on four supporting rollers, at a slight angle to the horizontal, similar to the action of a rotary kiln, but at much higher speed. From 180 to 330 tons per hour of material will be introduced at the uphill end of this drum and will be converted into small balls or pellets, due to the combined rotating action and the scraping action of a reciprocating "cutting bar" inside the shell. For further information write the Hardinge Co., Inc., York, Pennsylvania. Circle No. 18.

Three New Separators For Lab, Pulps and Oil Stream

Frantz FerroFilters, made by S. G. Frantz Co., are said to be capable of making delicate separation of minerals throughout the entire range of magnetic susceptibilities. The Isodynamic filter puts a new tool in the hands of researchers and laboratories. The company also has available a line of wet and dry electromagnetic separators for the removal of iron contamination from wet and dry materials. They consist essentially of a stack of grids, strongly magnetized by DC current and have no moving parts. The wet and dry electromagnetic separators are designed for tonnage lots. A similar separator that consists of permanent magnetic grids is available for the extraction of iron and steel particles and chips from circulating lubricating and hydraulic oils. Circle No. 54.



New Bin Level Indicator For Corrosive Atmospheres

A new, automatic bin level indicator for applications where corrosion and chemical action may be factors is being introduced by The Bin-Dicator Company. The body is made of aluminum and the diaphragm is stainless steel. The new unit can be attached to bin walls or suspended in a silo at any desired level. Circle No. 33 or contact the company at 13946-124 Kercheval, Detroit 15, Mich.

Fuller Acquires Facilities Of Traylor Engineering

The conclusion of the purchase of Traylor Engineering & Manufacturing Company, Allentown, Pa., by an exchange of stock, was announced by Fuller Company, Catasauqua, Pa., General American Transportation Corporation, Chicago, and Traylor. Fuller is a wholly-owned subsidiary of General American. Traylor will be operated under Fuller management, and personnel and facilities will otherwise remain unchanged. Traylor was organized in 1902, as designers and manufacturers of mining, smelting, cement and other rock products processing machinery. Fuller was organized in 1926 and is the world's largest designer and manufacturer of pneumatic conveying equipment and systems.

UPPER 2 CARDS ENABLE

5 Big Advantages of EUCLID'S TC-12 Twin-Power Crawler

Functional "years ahead" design, combined with unequalled power, makes the new series TC-12 the best all-around performer in the big tractor field. Its big power and big performance helps beat the pinch on profits...on every kind of big tractor work. Check these cost-cutting features:

Twin Engines with a total of 425 net horsepower . . . separate Torqmatic Drives each consisting of torque converter and semi-automatic transmission...more workability for heavy dozing, ripping, push-loading and towing than any other "super" tractor.

Independent Track Drives give the big TC-12 almost unbelievable mobility and maneuverability. With its separate power train and Torqmatic Drive, each track can work all the time because its power and speed is individually controlled. Operator has immediate, positive control for quick turns and side slope work.

Rigid Track Alignment is constantly maintained because each track is positioned to its main frame...each half of the tractor oscillates on a big diameter transverse shaft which provides maximum traction in rough going and increases track life. The tractor can be easily split into two halves for transport from one job to another.

Fast, Easy Operation is achieved by the separate Torqmatic Drives and simple controls. There's no master clutch...changes from one speed range to another are made under full power. Excellent visibility front and rear, and comfortable operator's seat, help to increase productive capacity. Good machine balance and stability, and "fast on its feet" performance, make the TC-12 unequalled for any big tractor work.

Service Accessibility that cuts downtime to a minimum is a feature of TC-12 design. Unitized assembly of converter, transmission and drive case components permits fast servicing or replacement without major tear-down of other parts. For example, both drive sprockets can be removed or replaced in about one-third the time required for the same work on a competitive big tractor. Planetary final drives can be serviced without breaking track or pulling sprocket.

Whatever the job, if it's a big tractor application the TC-12 is your best choice. This Twin-Power crawler gets more work done every shift with less downtime than other big tractors. Ask your Euclid dealer for facts that show why the TC-12 brings the best return on investment.

GM GENERAL MOTORS EUCLID

EUCLID EQUIPMENT

FOR MOVING EARTH, ROCK, COAL AND ORE

DUST SAMPLER designed to measure dust particles discharged from dust control equipment and to determine equipment operating efficiency has been announced by The Day Company of Minneapolis, Minnesota. The new unit is called the Iso-Kinetic dust sampler. Circle No. 39.

NEW COMPRESSOR has been added to the line made by Ingersoll-Rand Company. The new model is a portable rotary unit which supersedes the Gyro-Flow 210. The new compressor is a 250 cubic-foot-per-minute size. Circle No. 8.

SWEAT BANDS for workers foreheads are available in two models from Mine Safety Appliances. One is held in place by an elastic band; the other is designed for use with hard hats and welding helmets. Circle No. 9.

HEAVY DUTY SCREENS and specifications are described in a new 16-page bulletin by Pioneer Engineering Co. One major improvement to the company's line of Mesabi screen is the addition of secondary spring type of suspension. This is said to eliminate transfer of vibration to supporting structures and reduce strain. Circle No. 10.

NEW EARTHMOVERS have been announced by International Harvester Co. Two of the units are 24-yard scrapers (models 495 and 295); the third is a low-silhouette, controlled dumping wagon which provides a heaped capacity of 40.5 yards (model 495 Paywagon). Circle No. 11.

CAR UNLOADING UNIT of new design is offered by National Air Vibrator Co. The new Navco HCP line is a heavy duty vibrator for railroad cars. Circle No. 12.

NEW BELTING for conveyors which utilizes a patented flange edge is now available from The MonoBelting Corp. The design eliminates the use of troughing idlers and is said to reduce conveyor cost and maintenance expense. Circle No. 13.

List information you want MINING WORLD to obtain for you on this card. WE'LL DO THE REST. No postage necessary if mailed in U. S.

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46	47	48	49	50	51	52	53	54	55	56	57	58	59	60

61	62	63	64	65	66	67	68	69	70
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DIAMOND DRILL DATA is covered in an 8-page booklet available from E. J. Longyear Co., 76 South 8th St., Minneapolis 2, Minn. Fundamental information is included on the uses of diamond core drills, function of major parts and types of drills and drilling rigs. Circle No. 34.

SELENIUM RECTIFIER: Syntron Company's cartridge-type selenium rectifiers (from ⅛ to ½-inch in diameter) are described in an 8-page bulletin. Small size makes these rectifiers useful in cable testing, Geiger counters, electrostatic precipitators, inverse peak suppressors, magnetic amplifiers, railway signalling and photoelectric equipment. Circle No. 36.

BELT WEIGHER: A new Belt (Stream) Weigher has been announced by the Omega Machine Co., a division of B-I-F-Industries, Inc. Known as Pneu-Weigh, this unit meets the needs of continuous process industries for measurement and control of flow of dry materials at low to medium rates from 0 to 3,000 pounds per minute. Circle No. 22 for further information.

INVESTIGATE the economy of operation, fine performance, and relatively low initial cost of the Case four-wheel-drive W-9 Terraload'r. The W-9 features excellent balance and stability to maintain traction on all four drive-wheels when digging or traveling with heavy loads. Circle No. 28 for free catalog on the Case W-9 Terraload'r.

ATTACHMENTS: If you have a special job for your Caterpillar machine, or want to give more versatile operation, "Attachments," a new booklet released by Caterpillar Tractor Co., can help you. For your copy, circle No. 17 on the reader service card.

MANITOWOC in Action is the title of an interesting publication recently issued by Manitowoc Engineering Co., Manitowoc, Wisconsin. Novel descriptions and uses of Manitowoc cranes and shovels are presented in this publication, descriptions which you may be able to use. Circle No. 42 for your copy.

PUMP BULLETIN describing the industrial applications of a non-clog Torque Flow Pump is available from Western Machinery Co. Circle No. 46.

List information you want MINING WORLD to obtain for you on this card. WE'LL DO THE REST. NO postage necessary if mailed in U. S.

Use same LW prime-mover in stripping and hauling

You save on original equipment investment . . . and reduce operating costs

Stripping overburden is different from mining out pay ore or rock. It is basically a *scraper* job—can be handled most economically by modern scrapers. They leave your shovels and haulers free to maintain steady production.

Yet, since stripping is not a continuous operation in most pits, you need a multi-purpose machine—one that can quickly switch over to hauling shovel-loaded material when you catch up on stripping of overburden.

You get this advantage with the LeTourneau - Westinghouse Tournapull® line. These LW machines keep equipment investment and operating costs low *all year long* because of their interchangeability feature (see panel). The prime-mover—major part of your original machine investment—interchanges with a variety of profit-making work trailers for other specialized duties. They handle your stripping, land-leveling, roadbuilding, pit-hauling, and waste product disposal efficiently, and at low cost.

Cut costs on your operation

The next time you consider investing in new stripping or hauling machinery, investigate Tournapull. Ask about the multiple work bonus you get (at fractional cost) from its interchangeable LW trail units. Ask for specifications and prices on all 3 sizes. All have road speeds of close to 30 mph, ability to turn 180° non-stop in less than their own length.

LW Tournapull Scrapers in 3 sizes

Size	Diesel HP	Maximum MPH	Bowl Yards	Capacity Tons
B	335	31.7	28	32.5
C	226	33.5	18	20.0
D	148	29.5	9	10.0

Interchangeable Rear-Dump

Tournapull scrapers interchange with other LW trailing units behind the same prime-mover. For pit work, the Rear-Dump offers economical hauling ability, and simple operation — plus all the advantages of Tournapull speed and mobility. Bowl capacities are 35, 22, and 11 tons. Other LW trailing units, suitable for pit and quarry work, include bottom-dump and side-dump haulers.

LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Nobody Buys a Hole in the Ground

What you pay for is information, and information comes in the form of core—that wonderful petrified record of what the ages have left below the overburden.

And, when it comes to telling the truth, the whole truth and nothing but the truth, few of the world's records are so perfect and so available as core. Anywhere in the world, drive a coring bit into the earth's crust and nature pours forth her secrets, foot after foot, mile after mile, and—fact after fact. Sometimes the facts may be disconcerting to the theorists but, who can argue with facts preserved in rock and presented in a continuous stretch of core!

Before the diamond coring bit, geologists would piece together the story from chips flushed out with the sludge. Often, it was desperately slow and painfully expensive but was the best way available.

Diamond bits changed all that. Diamond bits not only cut down through tough formations with unbelievable speed and determination but, they did something that never had been done before—they delivered complete cores in which geologists could read the story for thousands of feet without the risk of missing some crucial section which might hold the secret that everybody was looking for.

Nowadays, most drillers know that for fast penetration, longer footage and 100% core recovery, you just can't beat Truco bits.

And Truco bits keep on proving it every day.

TRUCO DIAMOND BITS *by*

WHEEL TRUEING TOOL COMPANY

3200 W. Davison Avenue, Detroit 38, Michigan

WHEEL TRUEING TOOL CO. OF CANADA, LTD.
575 Langlois Avenue, Windsor, Ont., Canada

MEMBER Diamond Core Drill Manufacturers Association

IN BELGIUM . . .

Coal mine saves money with Tournapull hauler

Clamshell loads Tournapull with waste coal slurry at coal-washing plant. Tight-fitting tailgate permits unit to haul full rated-capacity (20-metric ton) loads of the semi-liquid material. S. A. Charbonnages Helchteren Zolder, owners of the unit, report only a minimum of time is required for a man to learn to operate the LeTourneau-Westinghouse machine, and that the operator is very comfortable in the Tournapull cab.

Until recently, the hauling of coal dust slurry from wash plant to drying pits at the Charbonnages coal mine, near Zolder Limburg, Belgium, was handled by conventional dump trucks. Then, because rough haul roads in the area had made truck maintenance a major cost problem, the mine owners, S.A. Charbonnages Helchteren Zolder, added a LeTourneau-Westinghouse Tournapull Rear-Dump to its fleet.

Faster, carries 5 times as much

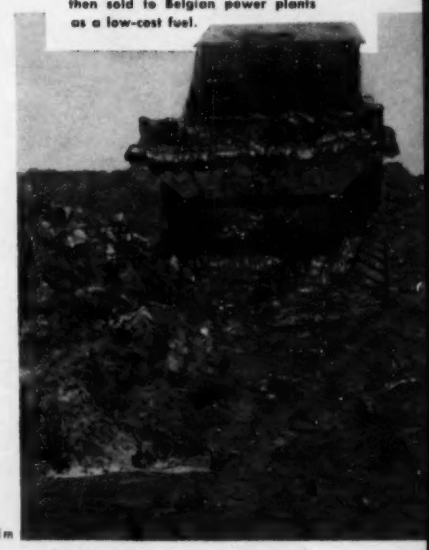
The new frameless, springless, 20 metric ton hauler has not only solved the maintenance problem, but has helped production. Plant Manager Wynen, for example, says that: "It saves us money. It is faster than a five-ton truck and carries five times as much pay load per trip."

Foreman Kerkhofs reports that the Tournapull's maintenance costs have been low. The LW Rear-Dump needed only a minor clutch adjustment in its first full three months of operation.

500 tons, per 8-hr shift

Taking its place in the regular production schedule at the mine, the Tournapull moves loads averaging 20 metric tons and completes 2 to 5 km (1.2 to 3.1 mi) cycles in from 15 to 20 minutes, depending upon the haul distance. Company records show it hauls an average of 500 metric tons per 8-hr. shift.

If you have difficult hauling or materials-handling problems, investigate electric-control Tournapull Rear-Dumps. Available in three sizes: 10, 20, and 31¾ metric ton capacities. Our world-wide LeTourneau-Westinghouse Distributor network assures you fast, dependable service anywhere.



Tournapull dumps heavy load of slurry at drying pit. This waste material is dried in the open air for about a year, later baked in kilns, then sold to Belgian power plants as a low-cost fuel.

Tournapull—Trademark Reg. U. S. Pat. Off. CR-2074-MJ-1m

LeTOURNEAU-WESTINGHOUSE COMPANY, - PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

MAUMEE COLLIERIES

At the Maumee Collieries in Indiana...

ANACONDA SHOVEL CABLE HAS A RECORD: 10 YEARS ON THE ROCK PILE!

Anaconda's SH-D Cable gives many years of dependable service in spite of heat, moisture, kinks, rocks and runovers!

How many shovel cable hazards can you count in this picture from the Maumee Collieries? Rocks . . . moisture . . . kinks . . . danger of runovers—they're all there. Yet the first installation of Anaconda's rugged SH-D Shovel Cable has resisted them all—*for 10 long years!*

It's proof again of the way Anaconda's in-the-field experience with Shovel Cable pays off in a superior cable for you. The important knowledge gained from use and testing of SH-D Cable *on the job* in our own mines goes into the design and manufacture of Anaconda Shovel Cable.

For example, the insulation is Anaconda Butyl (AB). Nothing can beat it for withstanding ozone, heat and moisture. Patented rubber cores cushion the ground wires and help prevent breaks from kinks and runovers. SH-D has a neoprene jacket that is exceptionally tough and abrasion-resistant. And every design, every component has been job-tested—your assurance of superior quality and performance.

Call on the Man from Anaconda with your cable problems. Or see your local Anaconda distributor. For new descriptive Bulletin DM-5818, "Anaconda Security-flex Portable Cables for the Mining Industry," write: Anaconda Wire & Cable Co., 25 Broadway, New York 4, New York.

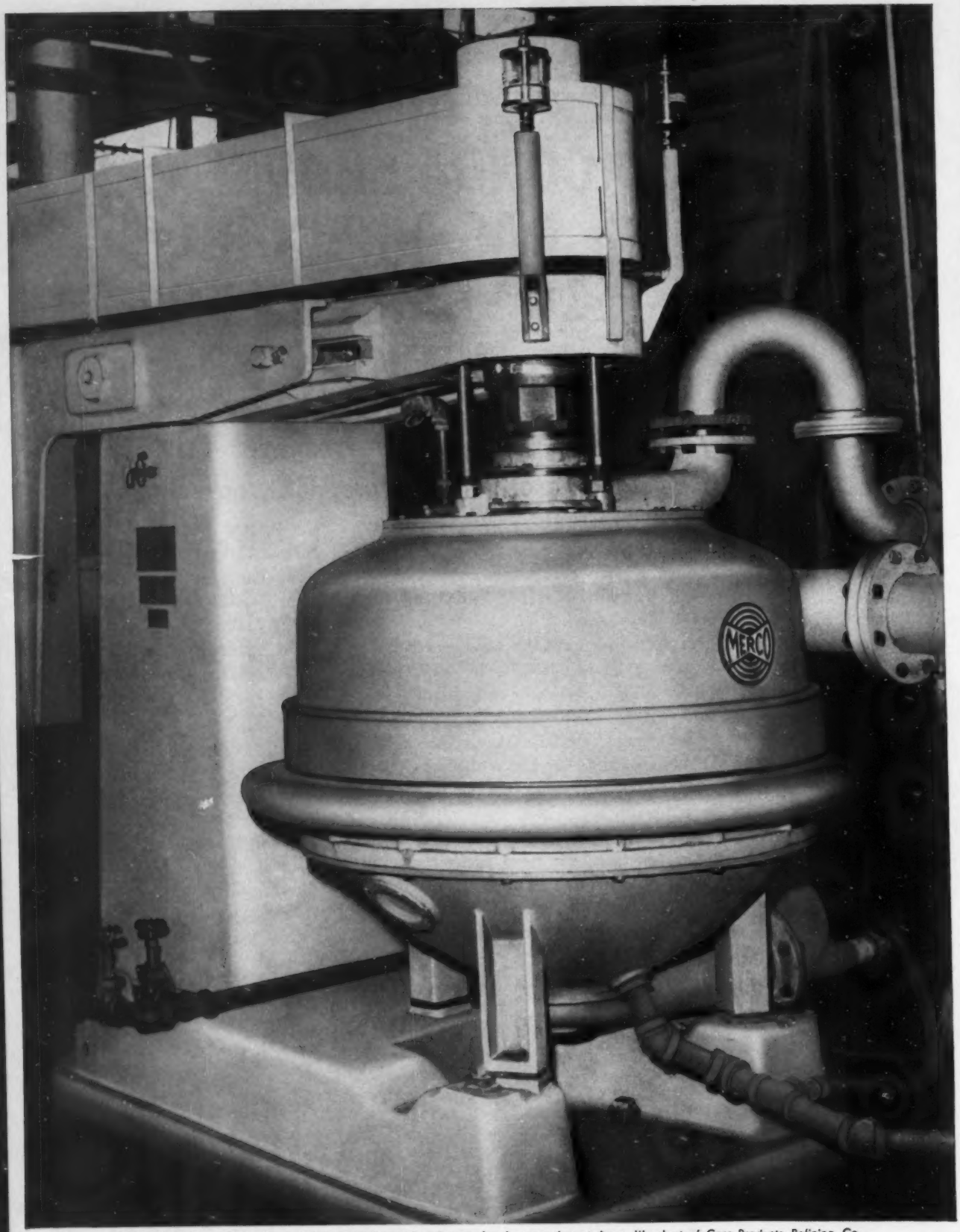
59212

◀ For a decade, the Anaconda SH-D Shovel Cable you see here has been giving dependable service for the Maumee Collieries, Jasonville, Indiana. Its many superior design features enable it to resist on-the-job hazards that would knock out ordinary shovel cables.

ASK THE MAN FROM

ANACONDA®

FOR **SHOVEL CABLE**



New H-30 Merco Centrifuge, with increased speed and capacity, in operation at Argo, Ill. plant of Corn Products Refining Co.

NOW...

increased capacity in NEW MERCO CENTRIFUGE for nozzle bowl applications

Rotor speeds up to 3300 rpm and capacities up to 600 gpm are now possible with the new, improved H-30 Merco Centrifuge. At the same time, power requirements per gallon of feed have been substantially reduced.

In the first two installations, this new unit produced comparable removals at nearly double the capacity of previous models . . . and showed *no increases* in total power consumption.

This new operating efficiency is a result of improvements in rotor design, which provides greater disc area. Feed passages have been enlarged to accommodate increased flow.

The new Merco H-30 Centrifuge is particularly useful for clarification and thickening of slurries which contain fine solids (0.5 micron) over a wide range of feed solids concentrations (.02% and up). It is now available with a 30″ stainless steel rotor and bronze or stainless steel housing. In addition to its new large capacity and higher speeds, it contains these standard Merco benefits:

- The unique return flow principle that permits concentrating, washing, clarifying, classifying and recovery of soluble values at pressures up to 150 psi.
- No nozzle clogging or solids build-up in the unit.
- Overhead drive eliminates need for submerged bearing.
- Hydraulic hoist is built in to simplify inspection and maintenance.

If yours is a process that needs a large capacity centrifuge, there is a place for the Merco H-30 in your plant. For further information, write to Dorr-Oliver Incorporated, Stamford, Connecticut.

Merco—Reg. T.M. Pat. Off.

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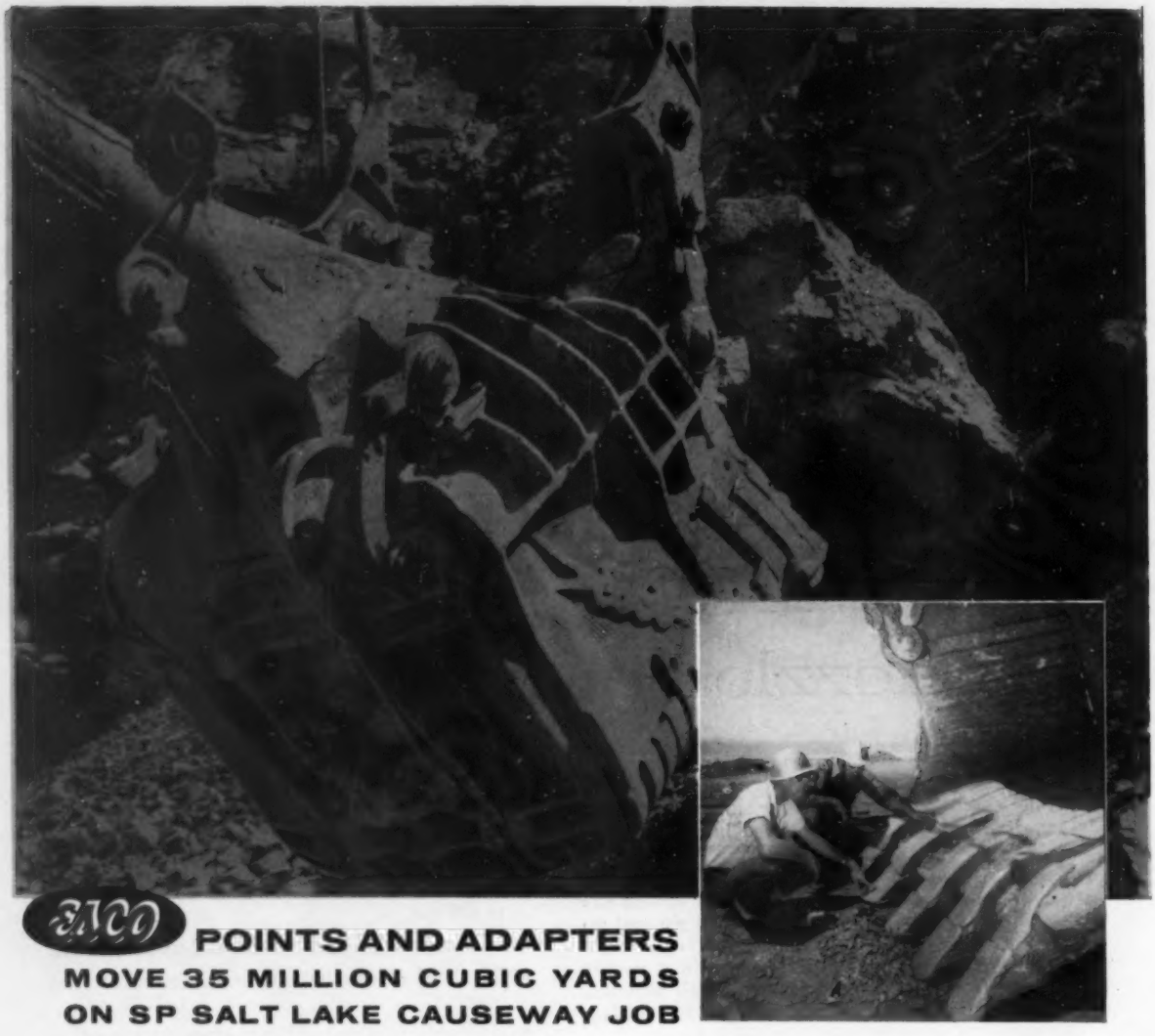

ESCO POINTS AND ADAPTERS MOVE 35 MILLION CUBIC YARDS ON SP SALT LAKE CAUSEWAY JOB

Shovel operators and mechanics, veterans in all types of rock excavation, say they have never experienced such severe digging conditions as the high silica content quartz being quarried by Morrison-Knudsen Company for the 13-mile long Great Salt Lake railroad crossing of the Southern Pacific Railroad.

ESCO points and wearcap adapters on M-K's dippers are quarrying the 35 million cubic yards of fill material for the mammoth causeway.

Increased point wear caused by this highly abrasive material makes the quick-change feature of *ESCO* points an important factor in keeping downtime to an absolute minimum. Easy-to-change *ESCO* points save at least half the time required in replacing bolt-on teeth.

ESCO Cast 12M Points and Adapters Cut Costs 4 Ways:

1. Quick-Change design reduces downtime. Four *ESCO* points can be removed, replaced in only five minutes.
2. *ESCO* points are quickly available for every digging tool from one convenient source.
3. Points feature self-sharpening design. There are eight point shapes to choose from.
4. Cast design permits extra metal at wear points. Points are heat treated, differentially hardened for long life.

See your nearest ESCO dealer. Ask for ESCO Tested Points Catalog No. 187.

ESCO®

ELECTRIC STEEL FOUNDRY COMPANY

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MFG. PLANTS AT PORTLAND, ORE. AND DANVILLE, ILL.
Offices in Most Principal Cities
ESCO INTERNATIONAL, NEW YORK, N. Y.
IN CANADA ESCO LIMITED

Money Making Methods

FLAT HOLES are loaded by blowing ammonium nitrate-Diesel oil mixture through plastic pipe with new "jetloder."

Nitrate With New Jetloader

To mechanize the loading of fertilizer-grade ammonium nitrate, Atlas Powder Company has developed the "jetloder" which uses compressed air to blow the blasting agent and sand stemming into blast holes.

Tests have demonstrated that the machine can blow 2½ pounds per second of ammonium nitrate and Diesel oil mixture into a 50- to 60-foot horizontal blast hole.

The only basic equipment required for use with the "jetloder" includes a compressor to provide air at 45 pounds per square inch; a truck or other device to move the compressor and blow loading machine and supplies; and a sufficient amount of 1¼ inch plastic pipe to reach from the machine to the bottom of the blast holes. This machine has no moving parts except the closing device and the valve which admits air.

In one recent test, a crew of three men primed, loaded, and stemmed five holes, varying in depth from 75 feet to 90 feet, in 90 minutes.

Each hole was primed with 80 pounds of Atlas Gelodyn No. 1 in 2-inch-diameter Twistite cartridges screwed together to form a continuous primer 40 feet long. Detonating fuse was connected to the outer end of the primer and the primer column was inserted to the back of the hole. The plastic pipe was placed in turn in each hole, and a total of 2,320 pounds of ammonium nitrate was mixed with oil and blown into the holes. The bags of ammonium nitrate were emptied directly into the machine. One gallon of Diesel oil was poured into the machine simultaneously with each 80-pound bag, with the "jetloder" doing the mixing during blow loading. Ten to 15 feet of sand were then blown into each hole for stemming. The holes were detonated and excellent fragmentation resulted.

SAFETY CAR LINK saves motor men's hands during coupling. Conversion from standard connecting link is simple job.

Bunker Hill Safety Link Saves Hands

A simple but effective device designed to eliminate accidents while mine locomotives are being coupled to cars has been developed at The Bunker Hill Company's mine machine shop at Kellogg, Idaho.

The new "safety link" goes a long way toward eliminating the danger of crushed hands and fingers during hookup.

Pieces of scrap shafting three and one-half inches in diameter and eight to 10 inches in length are the essential material. Channels are first burned in the side of the shafting with a cutting torch, so that the shafting can be inserted inside a standard eight-inch connecting link without distorting the shape of the link.

The shafting is then welded into place inside the link and a loop of steel is welded on top of the shafting to serve as a hand hold. By holding onto this handle, instead of the connecting pin as was done previously, the motorman can always keep his hands in a safe position.

Properly used this simple and inexpensive device positively prevents crushed hands and fingers, always a possibility with the former system. The hand hold keeps the hand high above the point of contact of the car and locomotive—in fact, the car and locomotive no longer come into actual contact, as the shafting acts as a buffer.

In addition, the shafting also acts as a roll bar and helps prevent underground derailments when a mine train goes around an extra sharp turn.

Effectiveness of the device is vouched for by assistant mine machineshop foreman Dave Boviall, who gives credit for invention of the device to Bunker Hill miner Ivar A. Jacobson.

Drill 4-Inch Holes with Carbide Bits

Four-inch-diameter holes up to 60 feet long are being drilled with tungsten carbide bits at Mount Isa Mines Ltd., Mt. Isa, Australia. These holes are being used for dropping sand fill into stopes, for air, water, and power cable ducts, and as a pilot hole to break to and follow when driving raises and drifts.

One man operated GISMO® Transloader

- . . . with round-trip travel 1,600 feet
- On shorter hauls tonnage ranges up to 2-tons a minute.
- On longer hauls, tonnage ranges down to 1-ton a minute.

This HIGH tonnage production is accomplished by:

One Man
One S-D Gismo Transloader

How can one man and one piece of equipment do so much work? Because the Sanford-Day Gismo Transloader is BOTH a mucking-machine and a truck ALL-IN-ONE!

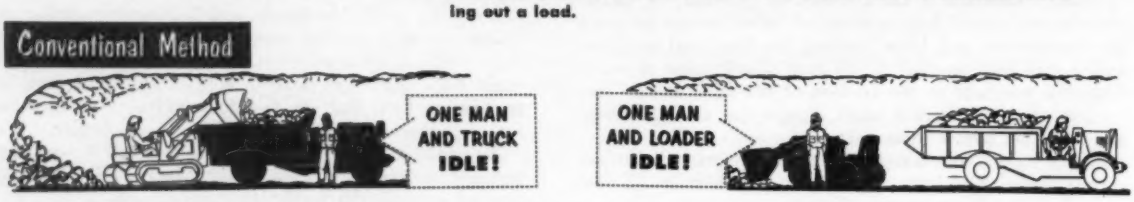
It is a high-speed transport — up to 20-miles per hour either direction! The fact it self-loads enables you to completely eliminate idle time of both men and equipment! Therefore, less capital investment required for additional equipment and manpower to do the job.

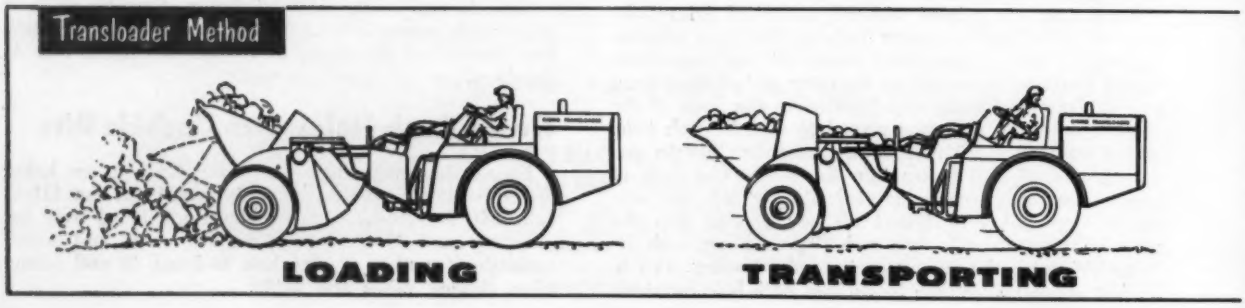
In conventional loading of materials, the loader is dependent on auxiliary equipment such as truck or shuttle car, etc. The loader cannot operate without the auxiliary conveyance. Neither does the haulage system operate while being loaded. Thus idling of men and equipment.

Compare this with the S-D Gismo Transloader. When Transloader is operating, man and equipment are working all the time; either mucking or transporting to dumping point! NEITHER THE TRANSLOADER NOR ITS OPERATOR ARE EVER IDLE! They are continuously at work in uninterrupted cycles!

Visualize one or several S-D Gismo Transloaders, each with only one man, MUCKING AND HAULING in your development or production work. Savings are tremendous! Write or call us today. *Manufactured by Sanford-Day Iron Works, Inc., Knoxville, Tenn.*

This photograph catches the action of the S-D Gismo Transloader mucking out a load.





"Mucks-Hauls-Dumps" 100-tons an hour!

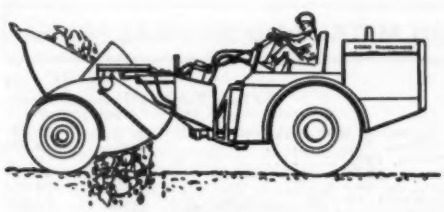
Here you see S-D Gismo Transloader with large, wide dipper down under hard rock. Transloader makes its own roadways and cleans-up completely . . . also moves large boulders for secondary blasting.

. . . and here is dipper raised with full load. This high-powered, high-speed Transloader operates on grades, in favor or against the load . . . negotiates, turns, etc.

This tramming scene (on way to raise) shows S-D Gismo Transloader as truck-transport.

Here load is being dumped into raise. Transloader also backfills waste, or dumps directly into bin . . . or by simple ramps over trucks, cars, conveyors, etc.

THE GISMO TRANSLOADER, rubber-tired Gismo Self-Loading Transport, is an advanced equipment development that is a perfectly natural result of the performance of the Gismo powered by crawler-mounted tractors developed a few years ago and doing an outstanding job in mechanized mining today!



DUMPING

SANFORD-DAY

KNOXVILLE, TENNESSEE

- S-D Mine Cars, all types and kinds.
- Precision S-D Mine Wheels.
- Tough, year-after-year wheel service by special S-D wheel Hard-Facing Process (this can really save you money and eliminate downtime).
- S-D "Brownie" Hoists. • S-D Car Spotters.
- S-D Mine Sheaves and Rollers.
- S-D Slusher-Trains for mining and construction industries.
- S-D Gismo Transloader for mining and construction industries.

"FLEXIBILITY AND LOW UPKEEP COSTS MAKE FLYGT PUMPS AN ADVANTAGE"

reports LUCKY FRIDAY SILVER-LEAD MINES CO.

While working a 750' shaft-deepening project from the 2300 to 3050 foot level, the Lucky Friday Mine ran into a dewatering problem which required pumping out an average of 150 to 175 GPM. At the start of sinking operations, air pumps were used, but because of periodic extra volume water seepage and excessive repair and maintenance costs, the air pumps were abandoned in favor of Flygt Model B-80L Submersible Electric Pumps.

In the pumping cycle, a Flygt Pump was lowered to the shaft bottom as soon after each blast as possible, and the water was lifted to relay pumps at a higher level, with heads up to 80 feet. The Mine Engineer, in a paper on the operation delivered before the Northwest Mining Convention, said of the Flygt pumping method: "Although the initial cost seemed high at first, the absence of expensive upkeep and the efficient pumping performance justified the investment. The quiet operation of the Flygt was a decided relief after listening to the siren-like air pumps. The Flygt Electric Pump was a distinct improvement over any type of air pump where large volumes of water had to be moved from the shaft bottom. It was low in upkeep cost and its unusual flexibility made it a definite advantage."

Since shaft sinking was completed, two Flygt Model B-80L Pumps now have become a part of the Lucky Friday's permanent mine pumping installation. In service since October 1956, they still are performing with a maximum of efficiency and a minimum of upkeep.

Flygt centrifugal Pumps range in size from 1½"-85 GPM capacity to 8"-3,000 GPM capacity. Head capacities range up to 210 feet. Weights range from 80 to 1200 pounds.

CHECK THESE FLYGT FEATURES

- ✓ Electric
- ✓ Resistant to Salt Water
- ✓ Submersible
- ✓ Easy to Handle
- ✓ Low Maintenance Costs
- ✓ Will Pump High Amount of Solids
- ✓ Heavy Duty
- ✓ Continuous Duty
- ✓ Runs Dry Without Damage
- ✓ Quick and Easy to Service
- ✓ No Installation Costs
- ✓ No Priming Needed

FLYGT

WEST OF THE MISSISSIPPI:

Stanco MFRS. & SALES INC.

1666 Ninth St.
(Corner of Olympic & Ninth)
Santa Monica, California

EAST OF THE MISSISSIPPI:

STENBERG MANUFACTURING CORPORATION

Hoosick Falls, N.Y.

U.S.A. Metal & Mineral Prices

METALS

MAY 15, 1959

COPPER: **Electrolytic.** Delivered F.o.b. cars, Valley basis (pound) 31.50¢
Lake. Delivered, destinations, USA 31.50¢
Foreign. Delivered Destinations, USA 31.50¢
Custom 32.00¢
LEAD: **Common Grade.** New York (Per pound) 12.00¢
Tri-State Concentrate, 80% lead, per ton $134.52
ZINC: **Prime Western:** F.o.b. E. St. Louis (Per pound) 11.00¢
Prime Western: Delivered, New York 11.50¢
Tri-State Concentrate, 60% zinc, per ton $64.00
ALUMINUM: **Primary 30 Pound Ingots (99% plus)** (Per pound) 26.80¢
ANTIMONY: **Lone Star Brand. F.o.b. Laredo, in bulk** (Per pound) 29.50¢
BISMUTH: (In ton lots) price per pound $2.25
CADMIUM: **Sticks and bars.** 1 to 5 ton lots (Price per pound 1.30
COBALT: **97.99%,** keg of 550 pounds (Price per pound) $1.75
COLUMBIUM: **Powder** Nom., per pound $55.00-$85.00
GERMANIUM: dioxide, high purity, gram 18.50¢
LITHIUM: **98%** (per pound) $11.00-$14.00
MAGNESIUM: **Ingots (99.8%)** F.o.b. Velasco, Texas, per pound 36.00¢
MERCURY: **Flasks.** Small lots, New York $245.00-$249.00
NICKEL: **"F" Ingots (5 pounds).** F.o.b. Port Colbourne, Ontario 75.50¢
PLUTONIUM: To July 1, 1962 AEC will pay $30.00 to $40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram $30.00
SELENIUM: **99.5%,** per pound $7.00
THORIUM: per kilogram $43.00
TIN: **Grade A Brands.** New York (per Pound) Prompt delivery $1.0262
TITANIUM: **99.3%** + Grade "A" Sponge (Per pound) $1.70-$1.82
URANIUM: **Red** (0.790 U-235) $16.00 Per Pound; Foil $16.75
U-235: **Nominal** (Per pound) $7,725
GOLD: **United States Treasury Price** $35.00 per ounce
SILVER: **Newly mined domestic.** U.S. Treasury price per ounce 90.5¢
Foreign Handy Harmon 91⅜¢
PLATINUM: Per ounce $77.00-$80.00
ZIRCONIUM: **Sponge,** Per pound, Reactor Grade $5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: **10 to 12% BeO.** F.o.b. mine, Colorado $46.00 per unit
Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at: 8.0 to 8.9% BeO, $40 per unit; 9.0 to 9.9% $45; over 10.0%, $48.00.
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons
African (Rhodesian). 48% CR_2O_3. 3 to 1 Ratio $40.00-$42.00
African (Transvaal). 48% Cr_2O_3. No ratio $28.00-$30.00
Turkish, 48% CR_2O_3. 3 to 1 chrome-iron ratio Nominal $45.00
U.S. Government ore-purchase depot Grants Pass Oregon. Buying suspended, quota filled.
COLUMBIUM-TANTALUM ORE: Per Pound Pentaxide Nominal $1.00
IRON ORE: **Lake Superior. Per gross ton Lower Lake Ports**
Mesabi, Non Bessemer, 51.5% Fe $11.45
Mesabi, Bessemer, 51.5% Fe $11.60
Old Range Non Bessemer $11.70
Old Range Bessemer $11.85
Swedish, Atlantic Ports, 60 to 68% Fe Contracts, Per Unit 25.00¢
MANGANESE ORE: **Metallurgical grade.** 48 to 50% Mn. Long ton unit $1.00-$1.05
Metallurgical grade. 46 to 48% Mn. Long ton unit $0.95-$1.00
Metallurgical grade. 44 to 46% Mn. Long ton unit $0.85-$0.90
Domestic U.S. Government. Small lot program f.o.b. railroad cars, minimum 40%. Base (48%) $2.30 per unit with premiums and penalties.
MOLYBDENITE CONCENTRATE: **98% MoS_2 F.o.b.** Climax, Colorado. Per pound Mo, plus container cost $1.25
TUNGSTEN CONCENTRATE: **Domestic.** 60% WO_3 Per short ton unit Nominal $20.00
Foreign. 65% WO_3 Per short ton unit (Scheelite) Nominal $13.00
Foreign: South American, Spanish, Portuguese Nominal $12.00
URANIUM ORE: F.o.b. purchase depot or company mill in accordance with AEC schedules and company buying contracts. Basic price is $1.50 per pound of U_3O_8 in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums, penalties where applicable.

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum **4.25 specific gravity,** per short ton $16.00
BENTONITE: **Minus-200-mesh.** F.o.b. Wyoming. Per ton, carload lots $12.50
Oil Well grade. Packed in 100 pound paper bags $14.00
BORON: Technical grade .... F.o.b. Boron, California. Per ton $47.50
FLUORSPAR: **Metallurgical grade.** 72.5 % effective CaF_2 content per short ton F.o.b. Illinois-Kentucky mines .... $36.00-$40.00
Mexican. 70% F.o.b. border $26.00-$27.00
Acid Grade. 97% CaF_2, Bulk, F.o.b. mine $48.00-$52.00
PERLITE: **Crude:** F.o.b. mine per short ton $3.00 to $5.00
Plaster grades. Crushed and sized. F.o.b. plants .... $7.00 to $9.00
SULPHUR: Long ton, F.o.b. Hoskins Mound, Texas $25.00
Export $24.00-$25.00

LONDON METAL AND MINERAL PRICES

May 15, 1959

				Per Long Ton USA Equivalent cents per pound[1]
COPPER:	Electrolytic spot	£234	5s Od	29.62¢
LEAD:	Refined 99%	£ 71	17s 6d	8.98¢
ZINC:	Virgin, 98%	£ 77	12s 6d	9.70¢
ALUMINUM:	Ingot, 95.5%	£180	0s Od	22.50¢
ANTIMONY:	Regulus, 99.6%	£197	10s Od	24.69¢
TIN:	Standard, 99.75%	£783	0s Od	97.88¢
TUNGSTEN:	Long ton unit	95s		$13.30

[1] With Sterling Pound at $2.80

Quotations on metals and certain ores through the courtesy of *American Metal Market, New York, N. Y.*

In-Place Leaching Planned On Large Scale by Miami

In-place leaching will be the cheapest method to recover a large proportion of the remaining copper in the Miami Copper Company's Miami mine in Arizona. Therefore, it has been decided to terminate underground mining operations about the middle of 1959.

In-place leaching of previously mined areas of the Miami mine accounted for 29 percent of the division's copper production in 1958. During the latter part of the year, the final section of the precipitation plant was completed as was the additional sump capacity and pump installation on the 1,000-foot level of the Miami mine. Additions to the solution distribution system on the surface, including new pumps and a pipeline network to facilitate leaching of the low-grade area after mining is completed, will be made this year.

Copper production by the Miami division in 1958 totaled 25,400,792 pounds. It came from 1,870,865 tons of ore, assaying 0.698 percent copper, which produced 17,919,666 pounds copper; and 1,800,352 tons copper solution from in-place leaching, averaging 0.208 percent copper, which produced 7,481,126 pounds copper. Additional Miami production came from its Castle Dome Division and the Copper Cities Division.

Open-pit mining at Copper Cities in 1958 yielded 36,072,087 pounds of copper from 2,768,390 tons of ore with a copper content of 0.79 percent. Overburden stripped in 1958 totaled 2,103,269 tons, resulting in a waste-to-ore ratio of 0.76 to 1.00. Water leaching of the old waste dumps at the Castle Dome Division produced 5,264,166 pounds of low-cost copper in 1958. Installation of necessary pipelines and a pumping system to distribute water to the top of the old dumps was completed during the year, making all dumps available for leaching.

Operations at the **Ray Mines Division** of **Kennecott Copper Corporation** at Ray, Arizona will be shut down from June 28 to July 11 inclusive, in order to provide a vacation period for employees. Normal operations will be resumed on July 12. Smelter operations, sponge iron and acid plant, and the precipitating plant will continue normal operations throughout the vacation period.

Arizona State University will offer the 4th annual course in Modern Industrial Spectroscopy to be held on campus from August 17 through 28, 1959. Particularly designed for chemists and physicists from industrial laboratories which make use of spectrographic and spectrophotometric equipment, this intensive course of lectures and practical work will serve to train personnel to staff these laboratories. The program includes basic theoretical considerations and practical instrumental training with lectures being given each morning and the afternoons devoted to laboratory work. The instructional staff will include members of the Departments of Chemistry and Physics at Arizona State University, augmented by invited guest speakers from industrial laboratories and technical personnel from manufacturers of analytical instruments. For complete information, please write to Dr. Jacob Fuchs, Director, Modern Industrial Spectroscopy, Arizona State University, Tempe, Arizona.

Consolidated Mining & Smelting of Canada Ltd., Canadian lead-zinc producer with principal operations at Trail, British Columbia, has established full-time geological representation at Tucson, Arizona.

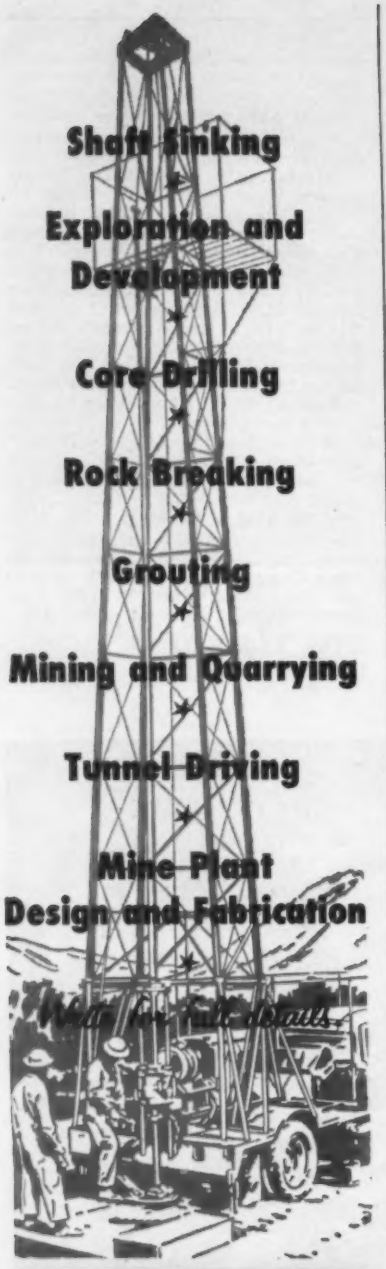
Sunshine Mining Company expects to close down its manganese operations at Bouse, Arizona, unless new reserves are provided for the concentrating mill. The company acquired a half interest in the mill, together with a lease on a nearby manganese deposit last year. The mill was rehabilitated, and the deposit stripped and prepared for open pit mining. Full-scale operations did not get underway until October and a portion of November was devoted to mining and milling for the non-operator's account from their leases. The remainder of November and all of December were devoted to production from the Sunshine lease. At year's end, a total of 73,105 long tons of ore had been milled, producing 4,824.9 tons of concentrate. The leased deposit did not prove to contain the essential tonnage, so unless the non-operator discovers new reserves to be milled for its account, operations will be concluded by Sunshine.

A new 150-ton mill is now processing lead-silver ore from the **McCracken** mine near Signal in southern Mohave County, Arizona, 72 miles south of Kingman. The milling and mining operation is being conducted by **Ari-Vada Development Corporation** under a lease-option from owner Ben Griffin. The mill is located at the old Signal townsite, some nine miles from the mine. Development of the property started more than a year ago. A small mill constructed by the firm proved insufficient and the larger mill was built. Mining has been conducted both open pit and underground, but will soon be done entirely underground. The company has estimated it has sufficient ore for 20 to 30 years of operation. P. H. Ransden is general manager and mining engineer in charge.

Phelps Dodge Corporation has been exploring a portion of the Detrital Valley Saline Project of **Goldfield Consolidated Mines Company** in Arizona. The area is near Lake Mead, about 35 miles from Hoover Dam. Two unsuccessful holes were drilled and a third hole is in progress in the contract area. The firm is seeking borax minerals.

Kennecott Plans Ray, Arizona Pit Extensions

Ray Mines Division of Kennecott Copper Corporation at Ray, Arizona plans a major expansion of its open-pit copper mine to the southeast. First expansion set for 1960 will also slightly expand the pit to the southwest necessitating razing 37 buildings in Sonora and eight in Barcelona. The second expansion phase set before 1964 will see the present pit limit extended to the east so that the business district of Ray will have to be moved and rebuilt. This is a part of the current $40,000,000 expansion program which will see the pit enlarged and deepened, and mill capacity at Hayden raised to 22,000 daily tons. Work is already well underway on construction of a new 7,500-ton steel ore bin at the Ray mine. At Hayden, new ore bins, a new crushing plant, and a new belt conveyor to fine ore bins are being constructed. Details showing how the Ray pit will grow as stripping extends for deeper mining around the present pit and as stripping of major ore extension get underway are shown in the photograph. Pit extension at "A" and "B" will be done by 1960 necessitating removal of buildings at Barcelona, "B", and at Sonora, "A". The Ray business district "C" will be moved to "E". A new state highway, 177, at "F" will eventually bypass Ray.



Cyprus Mines Corporation is operating its **Old Dick** mine at Bagdad, Arizona on a three-shift basis, milling 230 tons of ore per day. The lower or 650-foot level is being developed as planned, and sinking to open another level is to start shortly. The copper concentrates are sent to the **International Smelting and Refining Company** at Miami, Arizona; the zinc concentrates to International Minerals and Metals Corporation at Bartlesville, Oklahoma. Curtis Sundeen is resident manager, and Leonard Yount, mill superintendent.

Western Mining Associates, a California firm headed by Charles R. Jacobson of Santa Barbara, has leased the old **Golden** mine, 10 miles southwest of Aguila, Arizona, and is starting exploration and development work. John A. Hassell of Los Angeles, assisted by Howard S. Hotton, will direct the work for Western Mining Associates. Kenneth Crook of Wickenburg, owner of the Golden, has been retained as mine foreman.

The No. 5 shaft, serving the western part of **Magma Copper Company's** Main Vein, will be deepened about 100 feet during the current year for development of the 4,900-foot level. Diamond drilling has indicated a substantial tonnage of good grade ore between the 4,800- and 4,900-foot levels. Magma's mine production in 1958 totaled 391,084 tons of ore assaying 5.66 percent copper, 0.03 ounce gold, and 1.46 ounce of silver per ton, compared to 442,134 tons assaying 5.36 percent copper, 0.03 ounce gold, and 1.37 ounces silver in 1957. Metal production in 1958 totaled 41,315,344 pounds copper, 12,623 ounces gold, and 552,009 ounces silver.

Government floor price purchase options on **San Manuel Copper Corporation's** copper output continue under the DMPA contract negotiated in 1952, and are expected to remain in effect until the third quarter of 1960. In 1958, the company's copper was sold to the government at the "put" price of 27.05¢ per pound until October, when the market price rose above the contract price and so was then sold on the open market. With further operation of the contract's escalation clause, the "put" price has increased to 27.68¢ per pound, but no copper will be delivered to the government as long as it can be sold on the open market at or above the contract price. Last year San Manuel produced 11,486,300 tons of ore assaying 0.716 percent sulphide copper. Pounds of copper recovered per ton of ore mined averaged 13.01 in 1958, compared with 13.57 in 1957. San Manuel's metal production for 1958 was 149,401,672 pounds copper, 1,872,450 pounds molybdenum sulphide, 16.868 ounces gold, and 253,858 ounces silver. Metal production in 1957 was 119,797,769 pounds copper, 1,452,080 pounds molybdenum sulphide, 13,578 ounces gold, and 200,301 ounces silver.

The **California Mining Company** is reopening the old **St. John** mercury mine near Vallejo, California. The operation is headed by Carl Bloomquist who purchased the mineral rights to the property about a year ago and removed 500,000 yards of overburden to reach first ore at a depth of 40 feet. Surface operations are now down over 80 feet. The mine had been operated by underground methods many years ago but was hampered by water.

Continental Materials Company is undertaking an extensive exploration program at the **Guadalupe** mercury property in Santa Clara County, California. Large-scale geologic mapping, aerial photography, and portable drilling equipment have all been used to check the area. Principal activity is around the northwest extension area where surface and subsurface high-grade ore has been mined for the past two years by **Palo Alto Mining Corporation.** Mining is presently restricted to exploration of the Martino adit, from which some retort ore has been obtained, and to surface mining in an area discovered through the current exploration program. The bank of retorts has been closed down for repairs.

The $1,400,000 plant to manufacture a new coarse agricultural potash has been completed by **American Potash & Chemical Corporation** at Trona, California. Last year, the firm produced 714,653 tons of primary products, including borax, potash, salt cake, and soda ash; this total was 761,806 tons in 1957. Further operating economies were secured, reflecting technological improvements and additional capital investment.

Neodymium metal, one of the rare earths, is now available commercially from **Nuclear Corporation of America** at Burbank, California. The metal is capable of increasing heat resistance of magnesium, and should have wide applications. Until now, it has been available only as an oxide or salt.

The **Lowboy** uranium claims in the Austin mining district of Nevada have been sold to **White Caps Gold Mining Corporation** for $335,000. William Wilson and Gelnn Woods sold the claims for a sizeable down payment and monthly royalty payments. Included in the sale are two claims in the same area held by Charles Cavanaugh, Orville Carlock, and Robert Frank. A contract has already been negotiated with **Vitro Uranium Corporation** of Salt Lake City to handle all bonus ore from the property . . . that is, the first 10,000 pounds of contained U_3O_8 produced from the property. Stockpiling is in progress. No. 1 ore body is being mined by open-pit methods. On No. 2 ore body, an adit is being driven into the face and ore is also being stockpiled. This will continue until about 1,500 tons are on hand and then will be trucked to Battle Mountain for rail shipment to Vitro.

Round Mountain Gold Dredging Corporation has reopened its open-pit mining and gravel washing operations at Round Mountain, Nevada. Winter weather had forced suspension of work earlier in the year. Output was almost 10,000 yards per day when the shutdown occurred.

Union Carbide Nuclear Company is continuing to prospect its leased **Bisoni**

property, as well as its own staked claims in the area of south of Eureka, Nevada. Best indications to date are that several millions of tons of 0.75 percent V_2O_5 exist to depths between 200 and 300 feet. Many holes reportedly have bottomed in 0.50 percent ore. With 40 to 50 holes and several giant trenches more than 1,000 feet long, bulk sampling has been extensive. **Calumet & Hecla** is reported to be investigating claims north of this discovery.

NEW MEXICO

Federal Judge Carl Hatch has ruled that **Homestake Mining Company** is liable for damages to **Rio de Oro Uranium Mines** in a dispute over partnership arrangements. Rio de Oro, along with **United Western Minerals Company, White, Weld & Company, J. H. Whitney & Co. San Jacinto Petroleum Corporation,** and **Clyde Osborn,** had entered a partnership with Homestake called **Homestake-New Mexico Partners.** The partnership owns a 750-ton-per day mill at Grants, New Mexico. Then Homestake entered a second partnership called **Homestake-Sapin Partners** with **Sabre-Pinon Corporation** in which Homestake operated a 1,750-ton mill with ore supplied by **Sabre-Pinon** property. The judge ruled that Homestake had "breached the fiduciary relationship which ordinarily existed among partners." A breach of fiduciary relationship may occur when one partner furthers his own interest at the expense of the partnership.

The **Chino Mines Division** of **Kennecott Copper Corporation** at Hurley, New Mexico will be closed for two weeks vacation from June 14 to June 27.

American Uranium Company of Albuquerque, New Mexico has changed its name to **American Mining & Oil Company** in keeping with its expanded activities. The firm recently took over all mining properties of the **Colorado Mines & Metals Corporation** in New Mexico and Utah.

International Minerals & Chemical Corporation has installed a new type of shuttle car on the 900-foot level of its potash property in Carlsbad, New Mexico, and is checking its performance for possible wider application. The car is built lower and wider than older cars in the mine, but still has the same capacity for moving ore. It has only one electric motor, instead of four, and its power is transmitted through a torque converter. It has four-wheel drive, and four-wheel power steering. These features reportedly make it easier to operate and to turn the car in a smaller space. Discharge end can be raised or lowered, and it is geared to discharge at a faster rate. Its low height makes it very useful in the low country.

The **U.S. Potash Company** division of **U.S. Borax & Chemical Company** has installed a weightometer on the belt leading from the crystallizer plant to the number 2 warehouse. This had been the only circuit depositing finished product which was not metered. The installation will allow a closer check on the company's technical grade product which is stored in number 2 warehouse awaiting shipment.

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Copperhill Mine Installs New Fiber Glass Tower

The Tennessee Copper Company has installed a polyester fiber glass, resin-bonded tower at its smelter at Copperhill. The comparatively lightweight "open scrubbing tower," with an inside diameter of 11 feet six inches, cleans gas as it goes from the sinter plant (shown in left background) to the roasters. It reportedly handles five and one-half to six percent sulfur dioxide gas and removes a major portion of water. Water enters at the top of the tower through sprays and gas enters at the bottom, flowing counter-current to the water. The three and one-half ton tower was manufactured by the DuVeare Company, Springville, New York, and replaces a 75-ton tower (right background) made of steel lined with lead and inner-lined with brick, nearly 20 years ago.

American Metal Climax Inc. has entered the southeastern Missouri scene by establishing exploration headquarters at Salem. Two geologists have been assigned to the office and they are checking geological maps of the area for suitable exploration. **Bear Creek Mining Company** also has a Salem office, and is conducting mineral exploration in the area. First to call attention to the district were **American Zinc, Lead and Smelting Company** with its activities in the Boss-Bixby area, and **St. Joseph Lead Company** with its development in the Viburnum area.

Kaiser Aluminum & Chemical Corporation has purchased 3,000 acres of farm land in Randolph County, Illinois after taking option on it several months ago. The firm reportedly plans to build a steel mill, and the purchased land offers close proximity to coal fields. Also the **Missouri-Pacific Railroad** is planning to construct an all-purpose bridge across the Mississippi River at this point to carry railroad trains, as well as vehicular traffic. This would conceivably provide easy access to the **Meramac Mining Company's** iron mines under development at Pea Ridge.

Good progress is reported from Viburnum, Missouri where **St. Joseph Lead Company** is developing a high-grade lead deposit. The first shaft, near Dillar, has been bottomed at 804 feet and drifts are being driven in several directions. A permanent crew of 20 to 25 men are at work. A private road has been built from this shaft to the mill site. The second shaft, located near the plant site at Viburnum, has been collared. Several buildings are under construction, including the crusher building, and the mill bin foundation has been laid. The Viburnum townsite is under construction. A main street has been laid out, running east from Highway 49, and housing, water, and sewer installations are being built.

Mallinckrodt Nuclear Corporation has been awarded a contract to supply uranium fuels for the 15,000-kw nuclear reactor power plant now under construction at Kahl, West Germany. Mallinckrodt will furnish about 20,000 pounds of uranium dioxide to **General Electric Company** for conversion into pellet form. At Mallinckrodt's Hematite, Missouri plant, the firm is now converting gaseous uranium hexafluoride to uranium dioxide. Final shipment of the 20,000 pounds is planned to be completed by September.

The equipment and buildings of **Mid-Continent Mining Company** at Caulfield, Missouri were sold for $52,000 by the **General Service Administration** to satisfy a mortgage the agency held. Purchaser was the **A. Tanenbaum Company** of Little Rock, Arkansas. The zinc mine is owned by G. Earl Doane of West Plains and Lee E. Ives of Cleveland. They had leased the property to Mid-Continent.

Methods and equipment used in a small zinc mine and mill in the Upper Mississippi Valley zinc-lead district near Tennyson, Wisconsin are described in a Bureau of Mines report, Information Circular 7877—Zinc Ore Mining and Milling Co., Tennyson, Wisconsin. The operation is among the newer ones in the district, having begun full-scale production in 1955. A breakdown of costs, apportioned percentagewise among the various phases of operation, is helpful. The property is operated by **Piquette Mining and Milling Company**, a joint undertaking of **American Zinc, Lead & Smelting Company** and **Piquette Mining Company.** Write to the Bureau's Publications-Distribution Section, 4800 Forbes Avenue, Pittsburgh 13, Pennsylvania **for copies.**

Cancellation of a long-standing contract by **St. Joseph Lead Company** for treatment of lead concentrates by the **American Smelting and Refining Company** will result in closing the Asarco's lead smelter at Alton, Illinois in July. St. Joe Lead said it would have to cancel the contract because of the large inventory it now has on hand, coupled with the requirements of the Alton contract to supply a minimum of 3,000 tons of concentrates per month which had forced curtailment of St. Joe's own smelter at Herculaneum. Now St. Joe will be able to treat the entire output of its four-day operations, and will help to minimize operating loss at the Herculaneum smelter. Since St. Joe was Asarco's principal customer at Alton, and since the import quotas make it impossible to obtain an ore supply for the plant from other source, the firm announced the shutdown.

The Calloway "B" shaft of **Tennessee Copper Company** at Copperhill, Tennessee has gone into operation after three years of construction. Ore is now hoisted directly to the surface from the 24th level instead of being transferred at the 10th level to the Central shaft for delivery to the surface as formerly. The original plan had been worked out when it was thought that the ore body on the lower levels was smaller than it actually turned out to be. The company is also driving a 6,100-foot drift from the new Central shaft to the previously undeveloped "Schoolhouse" ore body. This will replace the recently depleted **Burra-Burra** mine. When the drift is completed, a new shaft will be sunk into the ore body to accommodate men and material.

American Zinc Lead and Smelting Company has reported its ore reserves in the East Tennessee district as totaling 85,000,000 tons, which is expected to yield 4,750,000 tons of 60 percent zinc concentrates. About 2,500,000 tons of this reserve were found through DMEA programs.

Appalachian Sulphides Ltd. has increased the milling rate at its **Ore Knob** copper mine in North Carolina from about 400 tons per day to 700 tons per day. During the first quarter of 1959, however, average rate was only 265 tons per day while arrangements were being made for the increased capacity. Appalachian is a wholly owned subsidiary of **Nipissing Mines Company.**

Kaiser Aluminum & Chemical Corporation has started a new potline for converting alumina to primary aluminum at its plant in Ravenswood, West Virginia. This brings to three the number of potlines in operation. A fourth is scheduled to open later this year. Each line has an annual capacity of about 36,250 tons of primary aluminum. Kaiser's over-all national capacity is now 466,250 tons per year with this addition.

Mallory-Sharon Metals Corporation at Niles, Ohio has reorganized its research and development team, following the firm's entry into refining and production of such special metals as zirconium, and hafnium. The department will have four basic objectives: fundamental work on metallurgy of titanium, zirconium, and other special metals to develop new knowledge; material process development required for commercial use, including heat treatments, melting processes, determining relationship of mechanical properties to processing methods, corrosion resistance and weldability studies; development of titanium, zirconium, tantalum, columbium, beryllium, hafnium, tungsten, and moybdenum and their alloys for anticipated corporate needs as established by the sales and marketing groups; provide metallurgical service to all corporate groups as well as to existing and potential Mallory-Sharon customers.

Cranberry Magnetite Corporation has acquired the old **Cranberry** iron mine in Avery County, North Carolina and plans to resume operations there. The mine

was operated intermittently from 1881 to 1931, producing over 1,500,000 tons of ore. In 1943 the U. S. Bureau of Mines examined the property and mined 1,400 tons of ore. It was concentrated in a pilot plant at the mine to a 70 percent iron concentrate, and in a pilot plant a Salisbury, North Carolina a sponge iron containing 97 percent iron was produced. The **Appalachian Exploration Company** spent the past year on the property. They estimate 300,000 tons can be recovered from the slopes above the present rack level; 100,000 tons can be recovered by trimming the oversize mine pillars; and 3,000,000 tons recovered by extending present workings southeast. Cranberry Magnetite has acquired the property through an exchange of common stock. It holds a 20-year lease on the mine and mineral rights on adjoining property. Present plans call for production of 100 tons per day of fine ground 70 percent concentrate suitable for media in coal washing plants.

IRON RANGES

The winners of the National Safety Competition conducted by the U.S. Bureau of Mines for 1958 were the **Pioneer** mine of **Oliver Iron Mining Division, U.S. Steel Corporation,** at Ely, Minnesota, for Metal Underground Mine; and **Erie** Commercial Mine of **Pickands Mather & Co.** at Hoyt Lakes, Minnesota, for Open-Pit Mine.

Mesabi Iron Company has filed an antitrust suit against **Republic Steel Corporation** and **Armco Steel Corporation,** asking a judgment of $67,500,000 damages. The complaint alleges that Republic and Armco each own 50 percent of the stock of **Reserve Mining Company,** and that Reserve acted as agent for Republic and Armco in connections with violations of the Sherman Antitrust Act. Mesabi's claim for damages is based on the alleged fact that it has a contract with Reserve under which it is supposed to get one-third of Reserve's "net profits". It alleges that Reserve, controlled by Republic and Armco, has been selling its entire product to Republic and Armco without allowing competitive bidding and without receiving from Republic and Armco a proper price for the pellets based upon the high quality of the taconite pellets and the advantages and savings resulting from their use by producers of iron and steel. The Complaint alleges that Republic, Armco and Reserve have violated the antitrust laws by entering into contracts and conspiracies in restraint of trade and commerce in the taconite pellet industry; by monopolizing trade and commerce in the taconite pellet industry; and by Reserve and Armco acquiring all of the stock of Reserve in view of the fact that such acquisition has substantially lessened competition and tends to create a monopoly in the taconite pellet industry. The Complaint also seeks an injunction based upon threats of future damage. It seeks an injunction against Republic and Armco continuing to exercise control over Reserve and requests that they be required to dispose of their stock holdings in Reserve.

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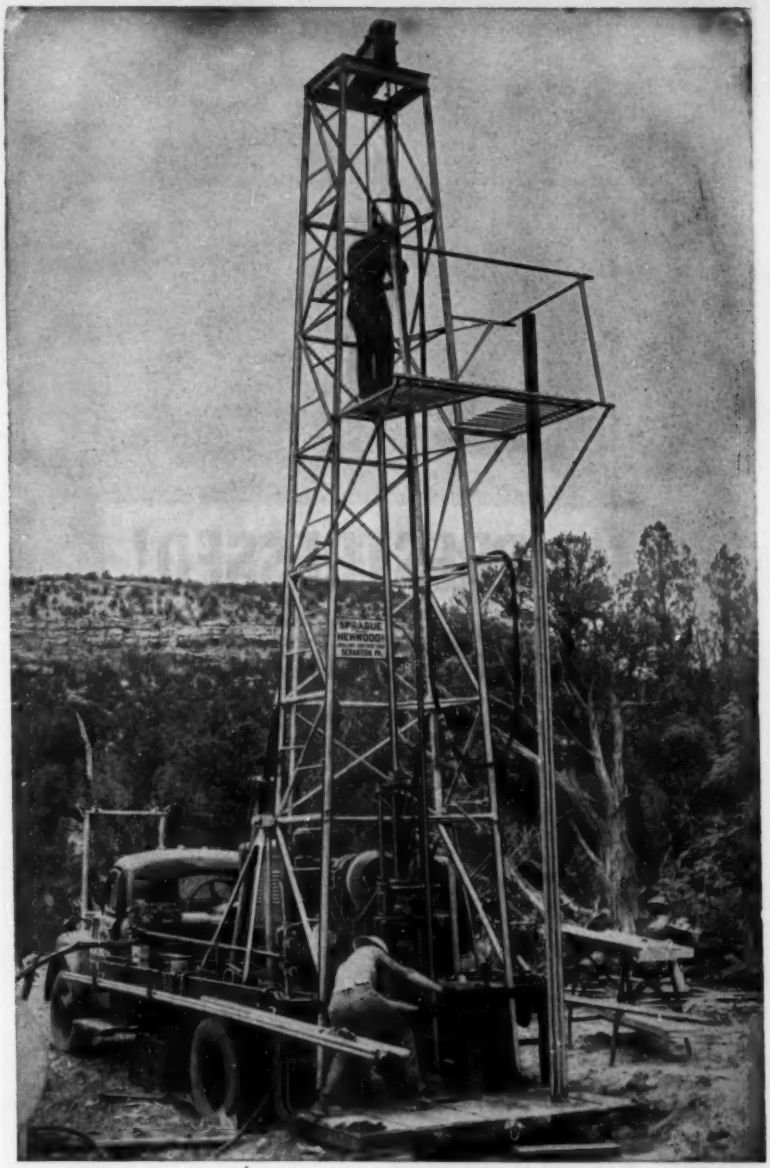

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CENTRAL AND EASTERN

A short course on Industrial Water Conservation is being held on June 8 and 9 at the **University of Michigan School of Public Health** in Ann Arbor. The course is designed to serve plant engineers and upper management, and will explore the question "just what is being done and what can be done by industry to cut down on its use of water."

Calumet & Hecla Inc. is driving a crosscut from the Osceola No. 13 shaft to mine a portion of the Calumet conglomerate at its property in northern Michigan. Ahmeek No. 3 shaft has about mined out its ore body. Development work in the Osceola No. 6 shaft was stopped late last fall. Mine output last year totaled 32,350,156 pounds. Overall grade of ore increased about 10 percent over 1957 and was the highest since 1945. Six shafts were in production at the end of the year. Output from the Tamarack reclamation plant was 2,817,781 pounds, about the same as in 1957. Recovered grade improved slightly.

The **Jessie H Mining Company** is using an electric suction dredge for stripping operations at the **Jessie** open-pit mine on Mesabi Range this season. The dredge has a rated capacity of 350 cubic yards per hour.

Iron ore shipments on the Great Lakes got off to an early and fast start this season. For April, according to the first 1959 report of the **American Iron Ore Association,** lake shippers loaded 2,978,023 gross tons at northern Lake Superior ports, both in the United States and Canada. This compares with only 62,560 tons in April 1958. The season opened with the worst ice conditions on the lakes in 20 years. A Coast Guard cutter escorted many of the first vessels, breaking ice ahead of the boats. Demand from steel mills is at a high level, and shippers themselves are anxious to get as much ore moved before July 1 as possible, because of a threatened steel strike. Total year's shipments are expected to be between 70,000,000 to 75,000,000 tons.

Oliver Iron Mining Division of U.S. Steel Corporation will operate 10 open-pit mines on the Mesabi Range and two underground mines on the Vermilion Range this season. The firm will also operate four large concentrating plants and three crushing and sizing facilities, as well as experimental taconite concentrating and agglomerating plants at Mountain Iron and Virginia. New sizing facilities and a second crushing unit to improve ore from the **Stephens** mine at Aurora were completed during the winter and will be in full operation this season. On the Eastern Mesabi, mining will be carried on at the **Rouchleau Group** in the Virginia area, and the **Stephens** open-pit mine at Aurora. In the western district, ore will be shipped from the **Sherman Group,** near Chisholm, the **Monroe** near Hibbing, and the **King, Plummer,** and **Arcturus** open-pit mines on the western Mesabi.

Three **Pickands Mather & Co.** mines are back in operation this season after inactivity last year. The **Bennett** mine at Keewatin on the Mesabi Range, the **Rabbit Lake** mine near Cuyuna on the Cuyuna Range, and the **Buck** mine on the Menominee near Caspian. The Bennett and Rabbit Lake mines were not scheduled for production in 1958, and mining was discontinued at the Buck mine in July because of the sharply reduced demand for ore last year.

The Polaris mill of **Hecla Mining Company** near Osburn, Coeur d'Alene Mining Region, Shoshone County, Idaho, has started treating silver-copper ore from the **Bunker Hill Company's Crescent** mine on a custom basis. Deliveries are between 100 and 200 tons a day. The mill had been operating on ore from Hecla's **Silver Summit** mine and the **Rainbow** mine but developed reserves at these mines are nearly exhausted. The Silver Summit mine has been allowed to fill with water from the bottom 3,400-foot level to the 3,000 level. Some ore has been found unexpectedly on the 2,900-foot level and a new exploration program is under way on the 1,750-foot level. A 1,600-foot tunnel is being driven to test the two veins which have yielded the bulk of ore taken from lower levels.

Sunshine Mining Company is doing downhole drilling below the bottom 4,000-foot level of the **Sunshine** mine in the Silver Belt of the Coeur d'Alene mining region, Shoshone County, Idaho. This level is about 1,000 feet below sea level. In the Rotbart area of the Chester vein, three holes have found ore 185 feet below the 4,000 level. In the Polaris vein system area, a hole has penetrated ore 140 feet below the level.

At the **Silver Mountain** deep exploration project east of Mullan, Shoshone County, Idaho, crews are approaching the principal objective. At last report, a crosscut being driven northeasterly from the shaft had progressed 5,700 feet to within 680 feet of a planned drill station. From there, diamond drills will probe beneath the old **Snowstorm** copper-silver mine. A long westerly exploration lateral from the shaft has been abandoned. This is a joint venture of **Hecla** and **Bunker Hill** mining companies, with government exploration aid.

At the **Tamarack** mine in the Coeur d'Alene mining district of Shoshone County, Idaho, all known ore below the No. 7 adit has been mined by block-leasing. Equipment has been salvaged from lower levels and they are filling with water. **Day Mines, Inc.**, owner, previously allowed the new lower workings in the **Hercules** mine at Burke to fill with water to the 1600 level following disappointing exploration on the 1900 level. Stoping is continuing between the 1600 and 1000 levels.

A 1,000-foot diamond drill hole has been driven southerly from the 3,200-foot level of the **Bunker Hill Company's Crescent** mine east of Kellogg, Shoshone County, Idaho, to test the Yankee Girl ore zone 2,400 feet west of the present most westerly working face in the property of Sunshine Consolidated, Inc. Low-grade silver mineralization was encountered. The **Sun Con** mine is being operated by **Sunshine Mining Company** from its deep levels.

The old Bayhorse Mining District in central Idaho, producer of more than $15,000,000 worth of high-grade silver-lead-copper ore, will be explored under a long-range joint venture of **Sidney Mining Company** of Kellogg and **Umont Mining, Inc.** of Salt Lake City. The agreement involves 41 patented and 121 unpatented claims covering nearly the entire district. Four of the mines have ore blocks suitable for block-leasing. A geo-physical survey was planned for this spring. Sidney will be the operator. Although the Sidney lead-zinc mine in the Pine Creek District of the Coeur d'Alene Mining Region, Shoshone County, is nearing exhaustion, the adjoining **Nabob** mine is being put into production by Sidney and it also plans production this summer from two uranium properties near Stanley, Idaho.

Central Farmers Fertilizer Company expects to open its $16,000,000 phosphate plant near Georgetown, Idaho this month. It will be one of the first in the chemical fertilizer industry to use elemental phosphorus rather than sulphuric acid in manufacture of superphosphates.

Directors of **Golconda Lead Mines** have acquired 7,000 shares of stock in **Hecla Mining Company** which recently acquired control of the **Lucky Friday** mine, whose ore is handled by the Golconda custom mill east of Wallace, Shoshone County, Idaho.

Idamont Oil and Mining Company has been organized at Grangeville, Idaho, to carry on mining and oil drilling in Idaho and Montana. Incorporators were Earl E. Botsford, Great Falls, Montana, Earl Johnson, Sheridan, Montana, and Charles L. Buck, Billings, Montana. The firm was capitalized for $250,000.

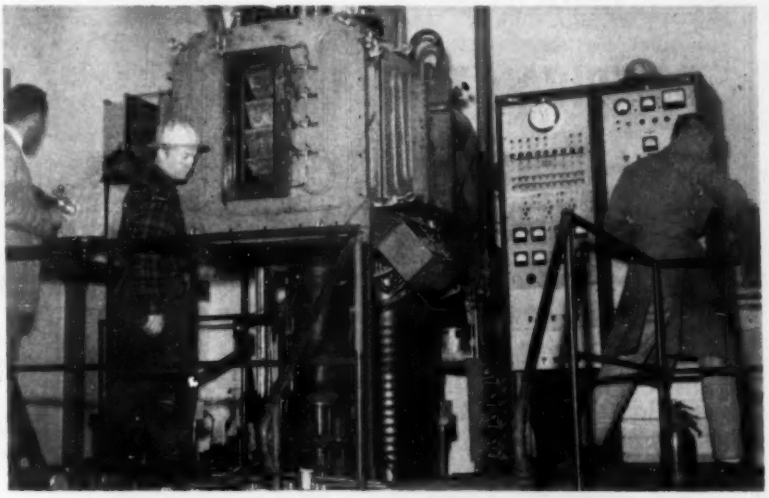
Rhodes Moller of Boise, Idaho has obtained a quartz mining lease from the state land board on 200 acres of land in Owyhee County.

The **Bunker Hill Company's** Kellogg electrolytic zinc plant has started manufacturing zinc anodes for protection of ship hulls, pipelines, and other metal products subject to corrosion damage. The ship-size anodes measure 6 by 12 by 1¼ inches, weigh 23 pounds, and include steel straps for welding the anodes to a ship's hull.

Echo Bay Lead-Silver Mines, Inc. is opening an ore vein intersected at the 400-foot point in its main adit and is drifting on the main vein at the 1,165-foot mark. Future plans include construction of ore bins, installation of electric power, and sinking. The mine is at Echo bay, Lake Pend Oreille, on the border of Idaho's Kootenai and Bonner counties. E. C. Schaeffer is president.

Emerald Creek Garnet Milling Company of Fernwood, Benewah County, Idaho, has been incorporated by William F. Craig and M. L. Joseph of Walla Walla, J. G. Drent of Fernwood, and Earl T. Siller of Kellogg. Capitalization was for $50,000.

The area beneath the old **Senator Stewart** mine at Kellogg, Shoshone County, Idaho, has been penetrated by a 1,300-foot tunnel driven by the **Bunker Hill Company** from its 1,100-foot working level. Bunker Hill, which is exploring **Silver Bowl** holdings at depth under a profit-sharing agreement, is preparing to "fan drill" the area from the tunnel. Holes up to 1,500 feet in length are planned.



Wah Chang To Install Electron Beam Furnace

The first commercial installation of an electron beam furnace to melt, refine, and cast special metals was made this Spring by Wah Chang Corporation at its Albany, Oregon plant. The furnace was designed and built by Stauffer-Temescal Company, Richmond, California. It will have a 225-kw rating and will be capable of the continuous melting and casting of high purity ingots, six inches in diameter and four feet in length, of such refractory metals as columbium. The novel electron beam furnace was developed by Stauffer-Temescal Company. Four experimental and semi-production units have been built and operated by Stauffer-Temescal. They have successfully melted such metals as tungsten, molybdenum, tantalum, columbium, hafnium, zirconium, uranium, beryllium, special steels, and rare earth metals. Electron beam refining broadens metallurgical horizons for the commercial production of ultra pure reactive metals because it combines the advantageous features of ultra high vacuum and of direct heating by electron bombardment. Wah Chang Corporation, one of the country's leading refiners of tungsten and kindred metals, has been licensed by Stauffer Chemical Company to operate the electron beam furnace on a commercial scale.

Construction of a 150- to 200-ton concentrator at the **Marietta** mine in Broadwater County, Montana, is planned by **Northern Milling Company.** The firm has made direct smelter shipments to East Helena and Anaconda. Ore is mined from several veins in andesite. W. R. Wade, Marysville consulting engineer, has been retained to design the differential flotation mill. The ore contains gold, silver, zinc, copper, iron, and arsenic sulphides. Harry Anders and Al Dance of Townsend, head the firm.

Two mining operations are planned in the historic Virginia City gold camp of Madison County, Montana. **Alder Gulch Mining and Development Corporation,** organized last fall, has put up buildings, installed equipment, and opened a vein of ore at the old **Alder** mine in famed Alder Gulch. **Easton Pacific & Riverside Mining Corporation** was incorporated recently to operate the **Easton Pacific** mine in Brown's Gulch. The **Riverside** mine north of Norris also has been acquired by this firm. Perry Blakeley is president of both companies. Roger Olson of Sauk Rapids, Minnesota is vice president.

Sinking of a 250-foot shaft has been started by **Nancy Lee Mines, Inc.,** at the **Nancy Lee** mine near Superior, Mineral County, Montana. The shaft will make possible mining of a shoot of silver-copper-lead-zinc ore located by diamond drilling. Crews have been working for a year reopening the main adit and driving 345 feet of new tunnel to the shaft site. Harry R. Thatcher, veteran shaft miner of Wallace, Idaho is in charge of the shaft sinking.

The **Montana Climax Corporation** has been organized in Phillipsburg, Montana to mine in the state. Properties the firm intends to operate have not been revealed.

The **Chemical Copper Company** of Three Forks, Montana has built a laboratory to carry on test work for its mine and mill located at Three Forks.

Mudhole Exploration, Inc., at last report, had virtually completed a 75-foot shaft in the southern foothills of Mount Spokane, Washington to open autunite discovered by a 43-hole drilling program. Dave Berry of Spokane is geologist and Adolf C. Nissen of Spokane is president.

Utahcan, Inc. is putting finishing touches on a new concentrator at its Jim Creek district holdings in Pend Oreille County, Washington, and it should go into operation this month. Installation of machinery was done in the winter months by a crew which stayed at the 4,500-foot elevation property. L. L. Lorang of Spokane is president.

Dawn Mining Company resumed mining and ore hauling operations from its **Midnite** mine and **Boyd** lease in the Spokane Indian Reservation, Stevens County, Washington on May 1 following a four-month shutdown. The mining is done by **Isbell Construction Company** of Reno, Nevada, under contract. Dawn operated its Ford, Washington uranium processing plant throughout the winter on stockpiled ore. Milling was on a three-shift basis. Current milling rate is 400 to 500 tons each 24 hours. Production in 1958 was valued at $6,168,102. **Newmont Mining Corporation,** New York, owns 51 percent of Dawn; **Midnite Mines, Inc.,** Wellpinit, Washington, the remainder. J. J. Crowhurst of Spokane is manager.

Heavy ground conditions have caused **Lakeview Mining Company** to abandon underground mining operations at its **White King** uranium mine near Lakeview in southern Oregon, and contract with **Isbell Construction Company** of Reno, Nevada to carry on open-pit mining. Rails, pipe, pumps, and other equipment were being removed from underground workings, at last report. The mine provides ore for the company's uranium processing plant near Lakeview. James F. Poulos is general manager.

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PROGRESS REPORT

B - 395

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World's Largest Covered Thickeners in Operation At U. S. Borax & Chemical

Four 230 ft. dia. Eimco-Process heavy-duty thickeners have been in operation for over a year at the United States Borax and Chemical Corporation refinery in Boron, California. These totally enclosed and insulated thickeners, largest of their kind in the world, are part of the CCD circuit from which the strong Borax solution goes to crystallization.

The thickener designs, developed in close cooperation with Pacific Coast Borax Division personnel and the engineering constructors, are custom-adaptations of Eimco-Process Type CX mechanisms. The cover of each unit is supported from radial trusses receiving central support from an 8 ft. dia. concrete column with steel shell that also carries the entire weight and torque of the thickener mechanism. The drive-head with split main gear and bearing was designed to the specific requirement of providing easy maintenance access. A special liquid seal was devised to protect the drive unit from tank vapors, as well as to ensure close control of process conditions.

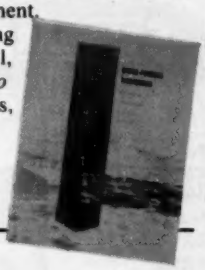
Four totally enclosed Eimco-Process thickeners at Boron, California

Other installation features were the resting of the steel thickener tanks on oiled sand for corrosion prevention; continuous torque recording; and handling the thickener underflows with steam driven reciprocating pumps.

This $20,000,000 processing plant, on an 80 acre desert site, was designed and constructed by Southwestern Engineering Company and Ford J. Twaits Company as a joint venture. It has substantially increased the U. S. Borax capacity and is playing an important part in the production of high energy boron fuels for the space age.

NEW BULLETIN AVAILABLE

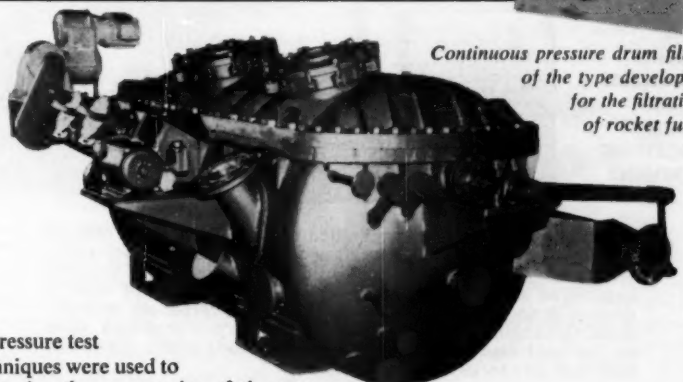
We recently completed an eight page bulletin describing our thickeners, hydroseparators, air-lift agitators, reactor-thickeners, slurry mixers and related equipment. It also covers recent design innovations such as our unique Thixo arms and platform lifting devices, and should be in your reference library even if your immediate plans do not include thickening equipment. A request will bring one by return mail, or, if your plans *do* involve thickeners, our nearest sales engineer will deliver a copy in person.



Eimco Filtration Equipment Plays Important Role in Producing Rocket Fuels

At another plant, producing high energy fuels, engineers were faced with a troublesome filtration problem. They had to filter a fuel having an extremely low slurry viscosity, a high percentage of hydrogen in the gas, and containing a dangerously flammable material.

This problem was referred to Eimco's Research and Development center at Palatine, Illinois. Here, the Company's filtration research engineers, after a series of tests, were able to work out special adaptations for a continuous pressure drum filter that met all the specialized application requirements.



Continuous pressure drum filter of the type developed for the filtration of rocket fuels

Pressure test techniques were used to determine the correct size of the unit. Intricate seals were devised to keep air out of the pressure vessel. Changes were made in the hydraulic system. And, the filter was furnished with complete instrumentation.

This is typical of how Eimco's unexcelled research facilities and valuable backlog of experience in engineering custom-designed filter equipment can solve difficult filtration problems.

U. S. Steel Moves Ahead On Wyoming Taconite

Another major step was taken recently in bringing the Atlantic City, Wyoming taconite deposit into production by the Columbia Geneva Division of U. S. Steel Corporation when application was made to patent claims on which the taconite is located.

Columbia Geneva holds a 75-year lease from the Ruby Company (J. R. Simplot) of Boise, Idaho on a large group of claims, and has done much surface and underground drilling, driven underground openings, and mined bulk samples for metallurgical testing. Such exploration and other improvements have cost $467,000 and form the basis for Ruby's application to patent 69 claims totaling 1,334 acres.

Exploration to date has indicated 300,000,000 tons of taconite assaying from 21.8 to 35.2 percent Fe. Proven reserves are estimated at 121,200,000 tons assaying between 28 and 32 percent Fe.

Simultaneous with the claims patent application, design engineers in San Francisco, California have completed an estimated 80 percent of the detailed design of a crushing plant, and magnetic concentrator to upgrade the ore to 65 percent Fe. Pelletizing or sintering of concentrate will be necessary before furnacing and could be done either at the new mill or the Provo, Utah steel mill.

It will cost an estimated $60,000,000 to develop an open-pit mine, build the mill, and a 60-mile-long standard gauge railroad north from Weston, Wyoming to Atlantic City for shipment of concentrate. U. S. Steel's Board of Directors must appropriate funds before plant construction can be started.

COLORADO

Rouville Mining Corporation is driving a 1,250-foot adit in the Red Mountain mining district near Silverton, Colorado, to cut a series of mineralized chimneys on the **Rouville** mining claims. The property is located between two old mines, the **Guston** and **Yankee Girl**, and is across the canyon from the **Idarado Mining Company** operations. The tunnel will bottom by 250 feet all pervious work done by former owners, and will drain the upper parts of the mine. Mining had been halted in the 1920's because of heavy amounts of water. After completion of the tunnel, a raise of about 300 feet will be driven to reach the old workings and to serve as the drainage outlet. Core drilling and prospecting has shown values in lead, copper, and silver.

Work being done by **Climax Molybdenum Company**, division of **American Metal Climax**, in sinking its No. 4 shaft (Winze) from the Storke Level has progressed to the 500 level station, located 200 feet below the collar of the shaft. This 700-foot circular shaft, which is 19 feet in diameter, is the first vertical shaft sunk by Climax since 1933. It will permit development of a new production level 300 feet beneath the Storke Level and will also allow access to another level to be developed 600 feet below the Storke.

Shenandoah Limited at Silverton, Colorado hopes to start slabbing of the **Gold King** tunnel next month from the portal to the face, a distance of about 6,200 feet. 52-pound rail is being used for the track, to accommodate 12-ton cars and locomotives. A Caterpillar D-7 has been delivered to the property, for use there and in other parts of the country. The Gold King tunnel is being driven under the **Sunnyside** mine, after which a series of raises will be made. Ore will be treated at the Shenandoah mill, but operations there will probably not start until late fall.

The Pride mill near Silverton, Colorado has been overhauled and should resume milling operations soon. The operation is managed by **Argyle Mining and Milling Corporation** and treats ore from the **Pride of the West** and **Osceola** mines.

Battershell and Greenwood are operating an underground thorite and rare earths property near westcliffe, Colorado, on Lookout Mountain. A pilot chemical mill is producing thorium. Leland Niles is mine superintendent.

Vanadium Corporation of America is achieving better results with its solvent extraction process this year. The company installed the process in its Durango, Colorado mill last year in order to recover more uranium and vanadium at lower cost. At the same time, the firm received a new AEC contract providing for enlargement of the mill. Elimination of the "bugs" in the new system took longer than expected and resulted in less concentrate production during the second half of the year. The firm is still operating the 140 claims in Calamity Mesa, Colorado which it is developing with **New Verde Mining Company** on a profit-sharing basis.

Philip Fidel Mining & Milling Company has been incorporated in Denver, Colorado by Philip N. Fidel, Jessie M. Fidel, and George F. Barbary.

Parker Mining and Milling Inc. has been formed in Denver, Colorado to engage in exploring, prospecting, and drilling for uranium. Incorporators are Richard Culna, L. H. Dukema, and Robert V. McFarland.

Idarado Mining Company anticipates that it has about 10 years of reserves of higher grade ore remaining in its property at Telluride, Colorado. During 1958, the firm milled a total of 382,100 tons of ore at its Pandora mill, averaging 0.08 ounce gold, 2.08 ounces silver per ton, 2.07 percent lead, 0.72 percent copper, and 3.48 percent zinc. In 1957, 457,850 tons had been milled. About 575,000 tons of low-grade ore in an active area of the mine was reclassified and dropped from reserves because of lower metal prices.

A new mill is being built by **Campbird Limited** at its **Campbird** mine near Ouray, Colorado. The old mill, built in 1960, was wrecked and removed pending new construction. About 30 men are currently employed and the crew is being steadily expanded as development work continues. The famous mine was owned by Tom Walsh, who made a fortune on its silver ore.

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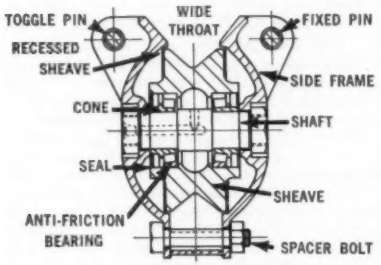

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UTAH

A $1,500,000 to $2,000,000 sulphuric acid plant reportedly will be built at Sulphurdale, Utah, about 20 miles north of Beaver. Initially the plant is to produce between 200 and 300 tons of sulphuric acid daily for sale to the uranium industry and to industrial interests in the Los Angeles area. Construction will start this year and is scheduled for completion in 1960. William Neale of Beverly Hills, California and his family hold the deposits at Sulphurdale through the **American Sulphur and Refining Company.** A 100-ton-per-day refining plant was built at Sulphurdale a few years ago but was not commercially satisfactory. The new plant will use FluoSolids roasting of the ore. The deposits, known locally as the **Cove Creek** deposits, are estimated to contain about 3,000,000 tons of 25 percent sulphur-bearing conglomerate rock.

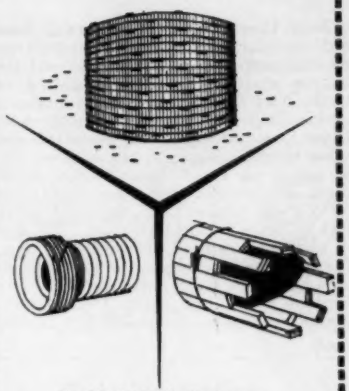
Radorock Resources Inc. and **Hecla Mining Company,** operator of the **Radon** uranium mine near Moab, Utah, are negotiating an agreement with **Uranium Reduction Company** for sale of Radon ore through 1966. The old contract would expire on March 31, 1962. The long-term contract provides for a 25 percent reduction in ore sold to the mill to 62,500 pounds of uranium oxide monthly. Stockholders voted approval recently of a merger of Radorock with **Chesapeake and Colorado Corporation.** Surviving firm is Radorock and Lester S. Harrison of Kellogg, Idaho is chairman of the new firm. Ralph W. Neyman of Salt Lake City is president and Bruce W. Odlum of Indio, California, is vice president.

Tonnage of lead-zinc developed last year by **U.S. Smelting Refining and Mining Company** from its **U.S. and Lark** mine in Tooele County, Utah was greater than tonnage extracted. Work was continued on the deposit level at the U.S. section in search of ore-bearing formations which were productive higher up in the mine. Several important new ore runs were developed in the Lark section. Although less tonnage of ore was produced in 1958, compared with the previous year, the grade was somewhat better.

Kennecott Copper Corporation, in its $172,000,000 program of expansion and integration from mine to market, plans to spend $10,000,000 in renovating and modifying the Garfield, Utah smelter which it acquired early this year. Expenditures for the firm in 1959 are expected to amount to $90,000,000, which includes most of the Kennecott operations in the United States.

Cog Minerals Corporation has suspended operations at its uranium upgrading mill in the White Canyon area of Utah but will maintain the 10,000 acres of uranium claims by necessary assessment work. The White Canyon mill was shut down early this year because of the inability to secure a satisfactory marketing arrangement for the products. Exploratory drilling is continuing on the claims.

The name of **Shumway Uranium Mining Corporation** of Salt Lake City, Utah has been changed to **Western Corporation.** Exploration work will be carried on under the name of **Westco Exploration.** Trent J. Parker is president.



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Bear Creek Mining Company is having considerable success in developing mineralization and some ore off the Burgin shaft in the Tintic district of Utah. The firm is prospecting under a multimillion dollar arrangement with **Chief Consolidated, Tintic Standard,** and other mining companies in that area. The president of Chief Consolidated, Cecil Fitch Jr., reports that since September 1958 Bear Creek has completed 2,040 feet of development work and 7,970 feet of diamond drilling. During this time, the firm has developed a minerialized area below the water table some 500 feet west of the Burgin shaft. The area reportedly measures about 300 feet by 600 feet. In drifting south along the southeast fissure, intermittent good showings of lead and silver ore were found near the west crosscut.

WYOMING

Western Nuclear Corporation is removing overburden in the amount of 1,000,000 yards per month from its **Frazier-Lamac** ore body in eastern Fremont County, Wyoming. Company officials say that 18,000,000 yards will be removed in the stripping operations.

Fremont Minerals Inc. has changed its name to **Susquehanna-Western Inc.,** in order to identify itself more closely with the parent company, **The Susquehanna Corporation** of Chicago. In addition to the 500-ton-per-day mill which Susquehanna-Western operates at Riverton, Wyoming, the firm also has a 125-ton-per-day sulfuric acid plant at Riverton. Expansion of the latter is under study. Allen D. Gray is president of Susquehanna-Western.

The **AEC** and **Lucky Mc Uranium Corporation** have signed a contract, effective July 1, 1959 until December 31, 1966, which permits an increase in ore processing from 833 tons to 980 tons per day, and purchase of increased quantities of concentrate by the commission. Actually the mill has a designed capacity of 1,500 tons, through minor changes in the flowsheet and remodeling of the mill over the past few months. These changes also improved metallurgy. It is planned to mill about 1,000 tons per day now, with poundage the limiting factor. Ore will come from Lucky Mc property in Gas Hills and Shirley Basin, **Lisbon Uranium Corporation, Green River Uranium Company, Four Corners Uranium Company, Heald Enterprises** in Crooks Gap, and Fuller at Copper Mountain.

The **Federal Uranium Corporation, Radorock Resources Inc., Gas Hills Uranium Company** partnership to build a $3,000,000 mill in Fremont County, Wyoming (see Mining World, May 1959, page 74) will be operated by a new firm called **Federal-Radorock-Gas Hills Partners.** Federal Uranium will be general manager of the venture. There are said to be more than 1,000,000 tons of uranium ore under the control of the group in the district and another 1,500,000 reportedly have been indicated by drilling. Federal has completed 300,000 feet of exploration hole drilling in the area. The firms will share on a basis of 30 percent each for Federal and Radorock and 40 percent for Gas Hills, after Federal and Radorock have recovered their expenditures in property development.

Fremont Mining and Manufacturing Corporation of Riverton, Wyoming has purchased a 160-acre gypsum property located three miles southwest of Lander. According to Ray Atwood, president of the new firm, the area contains about 70,000,000 tons of gypsum. The company has applied to the **Small Business Administration** for a loan to build a mill on the property. It is estimated the plant would cost between $1,000,000 and $1,500,000 and would employ 75 to 100 people. It is planned to blend the gypsum with rock phosphate, sulphur, and trace minerals, to make a soil conditioner.

Lucky Mc Uranium Corporation reports it realized a net profit of $3,161,482 on sales of $9,115,438 in uranium concentrates from its Gas Hills district uranium mill in Wyoming for the six months ended December 31, 1958. Although tonnage of ore processed in the last quarter of the year decreased 7 percent as compared with the previous quarter, production of uranium oxide contained in concentrate increased 12 percent because of higher grade ores and improved metallurgical recoveries. Shipped in the last quarter were 550,000 pounds of U_3O_8.

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INTERNATIONAL NEWS

UNION OF SOUTH AFRICA—A new company, **Electrolytic Metal Corporation (Pty.) Ltd.**, through an agreement with **West Rand Consolidated Mines Ltd.**, has been conducting tests in a pilot plant on the mine property for the electrolytic recovery of manganese from the uranium plant effluent. These tests have been economically successful and a full-scale plant is now being erected. The West Rand firm has acquired a 20 percent interest in the venture and is committed to support it further through loans.

FEDERATION OF RHODESIA & NYASALAND—About 26,000,000 tons of overburden have been removed from the open pits of **Nchanga Consolidated Copper Mines** in Northern Rhodesia. At the newest pit, the Chingola, about 6,500,000 tons have been removed since stripping started in April 1957, and 238,000 tons of copper ore have been mined since production started there in April 1958. The pit is now 200 feet deep. Its ore reserve is estimated at over 10,000,000 short tons with an average grade of 4.81 percent copper. Current output rate is 24,000 tons a month, and is expected to reach 40,000 tons a month by the end of this year. At the Nchanga open pit about 20,000,000 tons of overburden have been removed since stripping started there in 1955. Production started in April 1957 and about 2,500,000 tons of ore have been removed since then.

NIGERIA—A merger of **United Tin Areas of Nigeria** with **Ribon Valley (Nigeria) Tinfields** has been proposed. Provisional agreement has been reached, providing for a share for share offer by United to Ribon Valley shareholders on the basis of the companies' balance sheets at March 31.

UNION OF SOUTH AFRICA—**St. Helena Mines Ltd.** is now sinking its fourth shaft in the east-central section of the Orange Free State, and pre-sinking cementation of the shaft area is also underway. The milling rate is being steadily increased and improved to 138,300 tons monthly in the first quarter of this year, compared with 134,300 in the previous quarter. Higher values are apparent with increased development in the higher grade northeastern section. As expected, reef values are reflecting a higher grade with depth. At the end of 1958, ores reserves were 3,400,000 tons averaging 6.5 dwt. over 55 inches, or 357.5 inch-dwts., most of which is in the relatively lower grade eastern section, namely the sub-outcrop zone.

GHANA—Exploratory development under careful geological control is the keynote of future operations at the **Konongo Gold Mines.** The future of the mine now depends largely on finding additional payable exposures. The most encouraging development recently was in the footwall parallel drive on No. 12 level of the Boabedroo section where, to date, there was a continuous 185 feet of reef averaging 18.4 dwts. gold per ton over a width of 94 inches with the north face still in good values. Nothing is known yet of this reef on either the No. 11 or 13 levels.

FEDERATION OF RHODESIA & NYASALAND—Exploration will be carried out under the direction of **Rio Tinto (Northern Rhodesia) Ltd.**, on behalf of **Rhodesia-Katanga Ltd.** and the **British South-Africa Company**, with a view to finding workable coal deposits. Expenditure will amount to £150,000 over a three-year period. Rhodesia-Katanga controls the **Kansanshi** copper mine, now on a care and maintenance basis, but where a pilot plant for the treatment of the complex ore is expected to be built by mid-1959.

EGYPT—A Cairo newspaper has reported the discovery of a radioactive mineral deposit near Theres. Experts from the Egyptian **Atomic Energy Committee** are studying the deposit and reportedly preparing a program for development.

SOUTH WEST AFRICA—**South Africa Iron and Industrial Steel Corporation** has purchased the mine and mining rights of **Uis Tin Mining Company** in the Brandberg area of South West Africa. The mine treated over 1,300,000 tons of pegmatite, the average recovery being 0.11 percent tin. When production was suspended, there was no indication that in the existing workings a grade higher than that indicated by the recovery would be disclosed. Funds did not permit the extension of exploration, which might have disclosed higher grade ore. It is not yet known whether or when production will be re-

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sumed, and whether exploration on an extensive scale will be conducted.

MOZAMBIQUE—The Departments of Geology and Mining have been reorganized, equipped, and housed in Lourenco Marques. Efforts are being made to accelerate geological mapping. An overall six-year development plan is under consideration in Lisbon, and is expected to get underway in 1960. Perlite deposits near Lourenco Marques were drilled last year, and black sands on the coast near Quelimane gave interesting test results. The region around the Alto Ligonha pegmatites which had been reserved against prospecting was opened in July 1958 and several companies are exploring. There will be continued geological reconnaissance in 1959.

UNION OF SOUTH AFRICA—**O'okiep Copper Company's** ore reserves were increased by 2,000,000 tons last year, bringing total ore reserves to 28,670,000 tons averaging 2.18 percent copper. The gain came principally from the confirmation of additional ore in the Carolusberg area where reserves now average 1.7 percent copper. The firm plans to bring this area into production in 1962. During the last fiscal year, O'okiep produced 34,859 tons of copper. Its mill processed 1,590,000 tons of ore at an average grade of 2.25 percent Cu. Production is now running at a rate of about 38,000 tons per year.

EUROPE

SPAIN—A geological investigation is being made of the entire **Almaden** mercury district to determine future potential of the area. This has been the world's premier mercury producer for a number of years. The area is intensely mineralized, and even after many years of mining, there are undoubtedly many favorable structures still to be developed. Meanwhile, the Almaden company (**Minas de Almaden**) is proceeding with installation of another Pacific Foundry furnace to handle the ore.

YUGOSLAVIA—New discoveries of copper ore have been made in the Homolje Mountains of northeastern Serbia. About 200,000,000 tons are estimated to be on hand, containing an average of 0.83 percent Cu. This discovery will undoubtedly have an effect on the operations at **Majdanpek** where a flotation plant is currently under construction.

FRANCE—An International Conference on Strata Control is to be held in Paris from May 16 to 20, 1960. The conference is being organized by the **Centre d'Etudes et Recherches des Charbonnages de France (CERCHAR)**. The investigation of pressure and its effects in underground mine workings will be discussed. Results obtained from laboratory experiments and underground measurements and observations will be reported.

NORWAY—**A/S Titania's** iron-ilmenite ore reserves in southern Norway are now estimated at about 400,000,000 tons. Production of ilmenite concentrate in 1958 was 211,905 tons, and 42,020 tons of iron concentrate were also produced. This output is expected to be doubled in 1960-1961. Intensive research is under way to determine the best method of treatment in the future. The ore is presently floated,

but tests are being made with the Redox process, electric smelting, and L.T.S. process.

SCOTLAND—Test drilling has been underway on the island of Tiree in the Hebrides to determine whether there is sufficient iron ore to warrant commercial development. The deposits were discovered on the south side of the island during World War II. **Colvilles,** one of the largest steel companies in the United Kingdom, is reported to be backing the investigation in an effort to find local supplies of iron ore. At present, ore for Scottish steel mills is imported.

SPAIN—Drainage work in the old **Linares** lead mines has revealed 14 previously unknown veins in the old workings. At least 12 are considered to be worth development. The **Linares** district has been an important lead-zinc producer in the past. The dewatering project has been part of the **Plan de Fomento de Jaen (General Development Plan for the Province of Jaen).**

GERMANY—An iron ore deposit estimated to have an iron content of between 42 and 48 percent Fe has been discovered near Nienburg in Lower Saxony. A preliminary survey has indicated that there are about 400,000,000 tons of ore at a depth of 3,300 feet.

UNITED KINGDOM—The **British Sulphur Corporation Ltd.** is now publishing a quarterly magazine called "Nitrogen" which will cover all aspects of production and consumption of nitrogen in agriculture and industry. The firm already publishes a similar magazine on sulphur.

GREECE—After extensive testing of the fiber found in a Greek asbestos deposit, **Kennecott Copper Corporation** found the material to be satisfactory for use in the fast growing asbestos cement industry. The firm then exercised its option to purchase the property and is currently studying development plans.

SPAIN—The **Instituto del Hierro y del Acero** is organizing the 26th International Foundry Congress of the **International Committee of Foundry Technical Associations** and the Fourth General Meeting of the **Higher Council for Scientific Research Spain.** Both will be held in Madrid from the 4th to the 10th of October 1959. Among the events on the program will be the opening of the new plant of the Instituto del Hierro y del Acero at the University City. Following the technical sessions, there will be several Post-Congress tours to various sections of the country.

MALAYA—The recently completed air survey, made under the Colombo Plan, has indicated some strong magnetic lows in the Kinta Valley area. One such anomaly is in the Trans-Perak area, and has already been investigated, while another is a postulated fault north of Changkat Besout which will be investigated by a geological field crew. At least one of the two strong magnetic lows in proximity to the Batang Berjuntai alluvial tin field is expected to be attractive to private enterprise. The survey was made by the **Canadian Aero Service Ltd.** of Ottawa, with the Canadian government providing $200,000 and the Malayan government $150,000.

TURKEY—A Canadian firm is reported to be interested in 12 mining concessions in Turkey. **Anglo-Turkish Development** is the company, which plans to investigate 11 copper prospects and one lead prospect in eastern Turkey. Options are also held on silver, copper, and asbestos showings.

JAPAN—The **Japan Mining Industry Association** has revealed that the production capacity of domestic copper refineries is increasing. At the end of March 1959, total capacity for production of electrolytic copper was 16,766 tons, per month, an increase of 1,936 tons over the country's capacity at the end of March 1958. **Nippon Mining** now is capable of producing 5,000 tons, compared with 3,900 in 1958; **Mitsubishi** 3,000 tons, no increase; **Sumitomo** 2,400 tons, compared with 2,200 in 1958; **Mitsui** 1,830 tons, no increase; **Dowa** 1,422 tons, compared with 1,200 in 1958; **Toho Zinc** 500 tons, compared with 300; **Furukawa Electrolytic** 2,614 tons, compared with 2,400.

BURMA—The government's **Mines and Explosives Department,** which administers rules and regulations governing the mines of the country, has expanded its activities. The department now also covers mine safety and health research; ore testing and mineral dressing research; mining research; and metallurgical research.

KOREA—The **Natomas Company** of San Francisco, California is still testing

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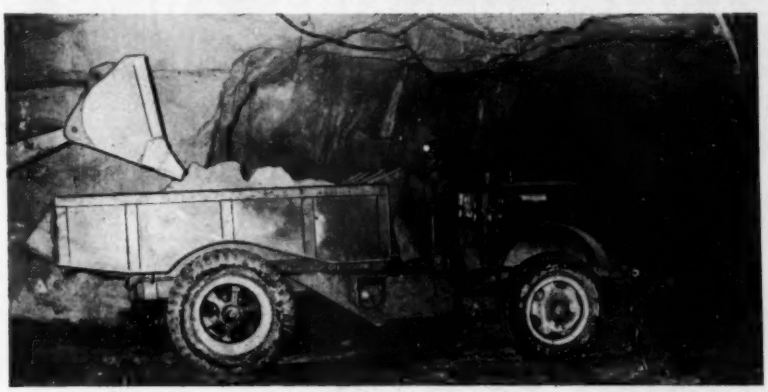

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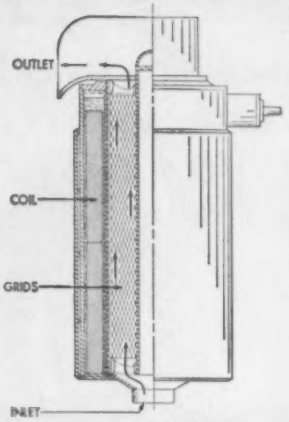

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INTERNATIONAL

a gold placer prospect in Korea which has shown early indications of economic values. The company checked this and another placer prospect last year, but abandoned one after an adequate number of holes failed to establish values sufficiently high to warrant a dredging operation. Natomas management believes that further development in Korea will depend not only on suitable ground, but also upon passage of certain new legislation now being considered by the Korean government.

INDIA—The government of India has approved the establishment of a zinc smelter in the private sector by the **Metal Corporation of India** at Udaipur in Rajasthan. It will allow the 15 percent sulphur content of the concentrate to be used for production of sulphuric acid. The output of zinc-lead-silver ore has gradually risen from 50 tons per day to a present rate of 500 tons per day.

BURMA—A large zinc deposit has been located by **Burma Corporation Ltd.** near Taungoo. It has been only slightly prospected, but because of the drop in zinc prices, further testing and prospecting has been discontinued. For the year ended June 30, 1958, Burma Corporation mined 121,770 tons of ore at the Baldwin mine. The zinc concentrates were exported and the lead concentrate smelted by the firm. A large recovery of silver was made from the lead.

CEYLON—Improvements are being made in the country's only monazite pilot plant. When completed later this year, it will be possible to resume production of refined monazite and to convert existing stocks of semi-refined grade into first quality. The improvements are also designed to eliminate the high tailing losses which exist at present, and to double plant capacity to about 250 tons of refined monazite per year. Monazite-bearing concentrates have been coming from the Beruwala and Kaikawala beaches on the west coast.

MALAYA—Malayan tin miners have formed a new union, the **National Mining Employees Union,** to replace the **Malayan Mining Employees' Union.** The latter was cancelled by the **Registrar of Trade Unions** when, among other infractions, it failed to submit its books and accounts, and did not show cause why its should not be cancelled. President of the new union is Inche Ismail bin Maroff, and union headquarters are in Batu Gejah, an important mining center in Perak.

OCEANIA

REPUBLIC OF THE PHILIPPINES—A re-evaluation of its ore reserves is planned by **Atlas Consolidated Mining and Development Corporation** for this year. Although development work last year added materially to the company's reserves, it became apparent that the average grade of ore had declined. At the **Toledo** copper mines, a total of 3,487,332 tons of ore averaging 0.69 percent copper was mined and milled during 1958. From this tonnage, a total of 76,755 tons of copper concentrates with an average grade of 27.04 percent copper and 15,434.5 tons of pyrite were produced.

NEW GUINEA—**King Island Scheelite Ltd.** of King Island, Tasmania will carry

out prospecting and development work at **Australian Gold Development's** gold property at Bismarck Range, Kainantu, New Guinea this year. King Island is already linked with **United Uranium N.L.** and **Loloma Gold Mines** on tin exploration work at Maranboy, Northern Territory. Its own mine at Grassy (King Island) has been on a care-and-maintenance basis since the middle of last year.

REPUBLIC OF THE PHILIPPINES—Diamond drilling during the past year in the general vicinity of the **Coti** ore body proved to **Consolidated Mines Inc.** that chromite exists at greater depth than previously known. Full extent of the chromite intercepted is not yet known; it may only be a small lens, or it may be part of the faulted southern extension of the main ore body. More work will be done on this in 1959. Refractory chromite ore reserves at the beginning of 1959 were estimated at 5,743,528 long dry tons, compared with 4,994,506 at the beginning of 1958, indicating that development exceeded production by 749,022 long dry tons.

VICTORIA—Mining activity continues in Victoria, although there have been developments of importance in the last month. **Morning Star Gold Mines N.L.** at Wood Point continues to locate small shoots of ore running from 10 dwts. to about 30 dwts. A subsidy keeps the mine alive. **Wattle Gully Gold Mine N.L.** at Chewton is to install ball milling equipment instead of the present stamps. The small copper mine near Lakes Entrance has sent a trial shipment of ore to Japan. Lake Boga uranium proved to be of no special interest.

NEW ZEALAND—A $6,000,000 aluminum fabricating operation will be set up in New Zealand by **Aluminum Limited** through its subsidiary **Northern Aluminium Company Ltd.** Initial annual production capacity will be 5,000 tons of sheet and foil products, and 2,000 tons of wire and cable. Exact location has not yet been determined.

REPUBLIC OF THE PHILIPPINES—One of the goals of **Baguio Gold Mining Company** this year is to reduce the underground working area of the **Gold River** property which is now connected through a total of 25 kilometers of tunnels, raises, winzes, and main shaft. The firm is attempting to systematically mine out sections where possible, preparatory to abandoning these areas and salvaging the rails and pipes for use elsewhere. During 1958 the company milled 140,635.39 tons, resulting in production of 29,685.334 ounces of gold. This compares with 138,941.43 tons milled in 1957 to produce 29,463.727 ounces of gold.

TASMANIA—Production of metallic aluminum at the Bell Bay plant of The **Australian Aluminum Production Commission** is about static at 10,500 tons per year. Imports from Canada are at a rate of about 13,500 tons annually, with additional small tonnages from Norway and Great Britain. Bauxite imported from Indonesia in the first half of 1958 amounted to 26,000 tons. **British Aluminium Ltd.** was actively considering taking over the Bell Bay plant when it was itself taken over by **Reynolds-Tube Investments.**

NORTHERN TERRITORY—**Peko Mines N.L.** is still working below capacity—shipping about 5,000 tons of copper per year to Port Kembla and 2,000 tons to Japan. Ore being stoped is a little over 7 percent Cu at present. The mine is being worked to the 830 level and, if it shows potential at depth, the firm may one day have its long-discussed treatment plant (flash smelting or fluosolids).

WESTERN AUSTRALIA—Crocidolite production by **Australian Asbestos** at Wittenoom Gorge is steadily increasing and is now at a rate of 13,000 tons per year. This deposit is capable of larger output but markets still are the governing factor. Asbestos exports from Australia (practically all from Wittenoom) are nearly 1,000 tons per month. On the other hand, imports of all types continue to increase and approximate 30,000 tons per year.

QUEENSLAND—**Mary Kathleen Uranium Ltd.** is "doing better than expected." Uranium oxide is now being produced at a rate of over £5,000,000 per year. Some fears have been expressed about water supply but, even without further rainfall this year, storage is said to be adequate until early 1960.

LATIN AMERICA

CHILE—**Cia. Minera Dulcinera** at Copiapo is reported to have started exploring the **Mina Dulcinera** in order to justify a new 500-ton flotation mill. An extension of the Dulcinera vein was dis-

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covered recently about 2,000 meters northwest of the present shaft. The Dulcinera mine is now producing 14 percent copper sulfides from work on the 990 meter level. This mine has the deepest shaft of any small or medium sized mine in Chile; it extends to the 1,010-meter level.

BOLIVIA—The Bolivian government paid about $182,114, to the **Patino Mines & Enterprises Inc.** for the first quarter of 1959, after estimated expenses. The sum is based on a small percentage of the price of tin and is applied against indemnification for the Patino properties which were confiscated and nationalized in 1952. A Bolivian government agency, **Corporation Minera de Bolivia**, operates the properties now. The sum was for tin contained in concentrates shipped from the mine. In the first quarter of 1958, the company received $125,301 after expenses.

MEXICO—The new haulage tunnel being driven at Avalos by **Compania Minera de Penoles S.A.** is more than half completed. It is expected to be in operation early in 1960. Last year more than 338,000 tons of ore were produced by the firm from its Mexican properties. From this and some custom ore, production totaled 30,000 tons of lead concentrate and nearly 50,000 tons of zinc concentrate. In addition, 4,000 tons of copper concentrate were produced from the copper orebody at the Avalos mines. Penoles is a 98.6 percent owned subsidiary of **American Metal Climax, Inc.**

ECUADOR—**Natomas Company** of San Francisco, California is conducting some test drilling work on its new gold placer concessions in southeastern Ecuador. The firm was assigned a concession covering some 150 kilometers along the Zamora and Nangaritza rivers last year.

CHILE—**Cia Minera Santa Fe** has started a stripping operation to expose a new section in the **El Dorado** mine. Plans are to strip about 700,000 cubic yards from this new section. The firm has also formed a steamship line in order to facilitate the transportation of Chilean iron ore. Laws pertaining to cargo vessels make it necessary to transport any type of cargo in at least one third Chilean bottoms. The new line is utilizing one 45,000 ton combination ore carrier and several smaller and older ships.

MEXICO—Shaft sinking is in progress at the property of **Cananea Consolidated Copper Company** to develop the underground ore body further. A 15,000-kw high-pressure turbine generator and auxiliary equipment are being installed at a cost of $3,300,000; this is to be completed by the end of 1959. During last year, the company produced 61,187,828 pounds of copper, compared with 58,029,067 pounds in 1957. The firm has an agreement with the Mexican government providing for reduced export and production taxes under certain conditions. Up to 50 percent of the cost of development of the copper deposit located below the

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La Colorada ore body and of the modernization and extension of present plant facilities can be paid for from the proceeds of the tax reduction.

ARGENTINA—Two major ore finds were made by **Cia. Minera Aguilar, S.A.** in its **Aguilar** lead-zinc mine last year. No further details have been revealed. The firm is a subsidiary of **St. Joseph Lead Company.** St. Joe and Aguilar have a 50 percent ownership of **Sulfacid S.A.** which plans to build a new 18-ton-per-day electrolytic zinc plant. The two firms also hold 43.3 percent of the stock of **Cia. Metalurgica Austral-Argentina S.A.** which produced 8,900 tons of zinc in 1958. The firm was handicapped by continuing power shortages; with sufficient electric power, the company could expand its production.

CHILE—The government's **Committee of Foreign Investment** has approved a $3,000,000 investment by **United Satamin,** a United States firm, in the **Sagasca** copper mines located in Antofagasta Province. The Committee has also approved a $5,000,000 investment planned by **Canadian Foreign Ore Development Corporation** to develop iron mines in northern Chile.

MEXICO—Production of lead, silver, and zinc during 1958 from the **El Potosi** mine of **Howe Sound Company** in Chihuahua averaged about 14,000 tons of ore per month, and is continuing at the same rate. The company closed its **El Carmen** copper mine at Batopilas, Chihuahua during the year when ore reserves were virtually depleted. A search for ore occurrences or extensions had been made without any success.

BRITISH COLUMBIA—**Highland-Bell Mines, Ltd.** is preparing to sink an inclined winze to explore ore intersections made by drilling below the 2900 level in the **Highland-Bell** mine near Beaverdell. The company milled 18,729 tons of silver-lead-zinc ore in 1958, first year that its 75-ton concentrator was operated a full 12 months.

QUEBEC—The iron beneficiation and pelletizing plants of **Hilton Mines** at Bristol are now producing at full capacity, or about 50,000 tons of pellets per month. Initial tune-up had started late in 1957 and increases in the treatment rate had been gradual. Mining is by open pit, with about seven tons ore and waste mined to produce one ton of pellets. Output is shipped by rail to steel mills in the United States and Canada. Hilton is owned by 50 percent **Stelco Mines Quebec,** actually a subsidiary of **The Steel Company of Canada,** and 50 percent by **Bristol Quebec Mining Company,** which in turn is owned by **Jones & Laughlin Steel Corporation** and **Pickands Mather & Co.**

NEWFOUNDLAND—To assist in correcting the serious world oversupply of lead and zinc, **American Smelting & Refining Company** has curtailed some of its mine production. Its Canadian subsidiary, **Buchans Mining Company Ltd.** operating at St. Johns, Newfoundland, will make a 10 percent reduction in its 1958 rate of output.

MANITOBA—With the signing of sales contracts with **Metallgesellschaft A.G.** of Frankfurt, Germany, **Montgary Explorations** is now reopening its **Bernic Lake** lithium property 110 miles northeast of Winnipeg. The first 1,000-ton shipment of amblygonite to Germany is scheduled for later this summer. A three-compartment shaft which is down to 307 feet has a main station at the 285-foot level. Diamond drilling on the property, together with work done by **American Metal Company** two years ago, disclosed about 9,000,000 tons of ore averaging 2.14 percent lithium oxide.

ALASKA—The **Miscovich Brothers** have reopened their gold placer plant at Flat, Alaska. Placering is being carried out in Black Creek where bedrock will be dug under old dredge tailings. A new mining method is being used this season. A back hoe, digging shallow gravel and several feet of bedrock, loads directly onto an 80-foot-long conveyor belt mounted on rubber tires. The conveyor discharges into a semi-stationary washing plant. Introduction of the belt conveyor gives flexibility to mining, extends the loading radius of the back hoe, and eliminates a bulldozer or other piece of equipment normally used to feed the washing plant. The rubber-tired, mounted

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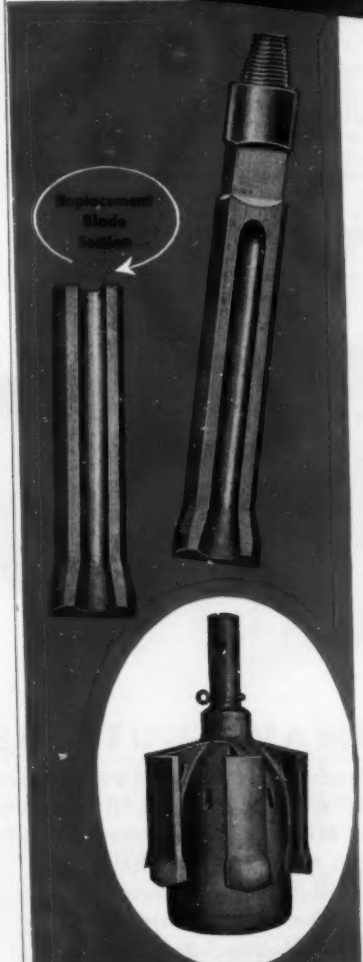

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conveyor can easily be swung in an arc around the washing plant by a back hoe or bulldozer as mining progresses. The back hoe was an effective digging depth of 12 feet.

BRITISH COLUMBIA—**Reeves MacDonald Mines, Ltd.** at Remac plans to diamond drill three anomalies found by a 1958 magnetometer survey of a 110-claim property adjoining the **Sullivan** mine of **Consolidated Mining and Smelting Company of Canada, Ltd.** at Kimberly. Reeves optioned the group from **Western Exploration Company** which retained a 30 percent interest.

ONTARIO—Dewatering of mine workings has been started by **Coldstream Copper Mines** at its property 90 miles west of Fort Williams, preparatory to reopening of the mines. Major financing must be secured before further work will be undertaken, but when this is forthcoming the shaft will be deepened another 650 feet. An underground crusher will then be installed. The Coldstream firm is controlled by **Noranda Mines.**

BRITISH COLUMBIA—Western Canada's first iron and steel smelter is being built by **The Consolidated Mining and Smelting Company of Canada Ltd.** The smelter will be the first stage in an integrated iron and steel operation costing more than $20,000,000 which will produce pig iron, steel ingots, and rolled steel products. Planned capacity will be more than 100,000 tons per year. Cominco's large reserves of iron (pyrite) tailings from the **Sullivan** mine at Kimberely will be the major ore source for the new project. The reserves are equivalent to over 15,000,000 tons of recoverable iron and have accumulated during the years. Current mine production increases these reserves by about 350,000 tons of iron per year.

ONTARIO—Sinking of the new No. 4 internal shaft by **Kerr-Addison Gold Mines Ltd.** near Virginiatown has been completed and work will start soon on three new deep levels. These will probably be 4,800-, 4,400-, and 4,000-foot levels. The No. 4 shaft is now bottomed just below 6,000 feet. Deep drilling has indicated competent rock to the shaft's eventual planned depth of 8,000 feet. Sinking of the No. 5 internal shaft will be started in 1960.

QUEBEC—A depth of 500 feet has been reached in the shaft deepening program at **Bateman Bay Mining Company** at its copper property in Chibougamau area of northwestern Quebec. Development on two new levels—the 375 and the 500 levels—is now underway. Values are in copper, gold, and silver. Shipments will be made to **Merrill Island Mining Corporation's** mill.

ONTARIO—**Nickel Mining and Smelting Corporation** is resuming developing of its **Gordon Lake** nickel-copper property which became a recession casualty last year. At that time a total of 3,500,000 tons averaging 1.2 percent nickel and 0.6 percent copper had been outlined. Immeriate plans call for deepening of the No. 2 shaft an additional 600 feet to 1,975 feet and an extensive program of underground development. The all-weather road to the property will be surfaced and arrangements will be made for hydroelectric power from a major transmission line 17 miles away. Five tons of ore were shipped to **Strategic-Udy's** metallurgical and chemical plant at Niagara Falls, New York. If the process is suitable for Nickel Mining's ore, the company hopes to adopt it. The firm was formerly called **Eastern Mining and Smelting Company** and was building a nickel-copper smelter at Chicoutimi, Quebec; the company might resume work on this project.

ALASKA—The **Little Squaw Mining Company** has been formed to operate in the Chandalar area of Division Four. Several hundred feet of drifting is being done on the Little Squaw vein, and work on other veins is also being considered.

BRITISH COLUMBIA—**Sunshine Lardeau Mines, Ltd.** has been looking at mining properties in the Lardeau area which could possibly provide ore for the firm's mill. The firm is operating primarily as an investment company, seeking special situations in mineral, oil, and gas development. **Transcontinental Resources, Ltd.** recently bought stock control. J. D. Mason is president of Transcontinental.

SASKATCHEWAN—A 400-mile-long road is being constructed from La Ronge to Uranium City by the Province of Saskatchewan under arrangement with the federal government. The road is one of three being constructed under this setup. Completion date is set for 1964. The new road may spark mining activity since it will be an all-weather road providing access to mineralized areas.

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6—Briquetting Presses: 75, 50, 10 HP.

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Ball Mill: 6x6 Allis-Ch., 440-v motor
Ball Mill: 5x4 Hendy; 440-v motor
Rod Mill: 4x10 Hardinge; peripheral dis.
Rod Mill: 3x8 Marcy; peripheral dis.
Rod Mill: 2x4 Marcy; trunnion dis.
Classifier: 6x18 Dorr DSF dplx-rake type
Flotation: 8-Cells 62x62 Wemco Fags
Flotation: 5-Cells 44x44 Wemco Fags
Flotation: 8-Cells 32x32 DECo. Sub-A
Crusher: 28x36 Traylor Bulldog Blake
Compressor: 1100 cfm actual Ingersoll vertical; 250 hp 2300-v syn. motor, etc. Unit new 1956
Muckers: Bimco 21-B and 12-B

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1—6'x4' Denver Ball Mill, 100 HP
1—64½ Marcy Ball Mill, 100 HP
1—4'x5' Colorado Iron Works, 30 HP
3—5'x14' Marcy Ball Mill, 100 HP
1—6'x16' Hardinge Conical Ball Mill, 50 HP
5—8'x9' Traylor Ball Mills, 250 HP
1—5'x8' Traylor Rod Mill, 150 HP
1—12"x24" Denver Rod Mill, 1½ HP

Blowers

1—15" LaDel Axial Flow, 1½ HP, 440 V
2—TM 6 Coppus Ventair, 5 HP, 440 V
1—24" Sturtevant Axial Flow, 5 HP, 440 V
6—TM 7 Coppus Ventair, 10 HP, 440 V
8—TM 8 Coppus, Ventair 15 HP, 440 V
1—Series 1000 Joy, 10 HP, 220/440 V, NEW
1—6000 CFM Roots Connersville, RS, 150 HP, 220 V

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18—18 cu. ft. C.S. Card, Z18, 18" ga.
41—20 cu. ft. C.S. Card, Z20, 18" ga.
11—30 cu. ft. C.S. Card, Rockerdump, 24" ga.
32—33 cu. ft. Ajax Type, 18" ga.
25—60 cu. ft. C.S. Card, Granby, 30" ga.
32—37½ cu. ft. Ajax Type, 18" ga.
14—84 cu. ft. C.S. Card, Granby, 30" ga.
5—85 cu. ft. C.S. Card, Granby, 30" ga.
8—93 cu. ft. C.S. Card, Granby, 24" ga.
7—100 cu. ft. C.S. Card, Side Dump, 30" ga.
14—130 cu. ft. C.S. Card, Granby, 30" ga.

Classifiers

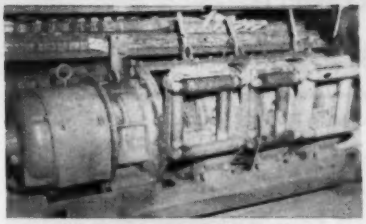
1—36"x15'-0" Wemco Model SCM, Spiral
1—45"x17'-3" Akins Spiral w/drive
1—6'x22' Dorr Duplex, Rake, w/5 HP
1—7'x25'-6" Dorr DSFX, Rake Type

Compressors

1—500 CFM Gardner-Denver, HAC, 100 HP, 440 V
1—625 CFM Ingersoll Rand, XCB, 125 HP, 2200 V
1—875 CFM XRE, 175 HP, Syn. 2200 V
1—1000 CFM Chicago Pneumatic, 0CB, 200 HP, 440 V
1—1050 CFM G.D., HA, 200 HP, G. E. 2200 V
1—2000 CFM Worthington, 400 HP, 2300 V
1—2500 CFM Sullivan, WN4, 400 HP, West., 2200 V
1—3000 CFM Ingersoll Rand PRE-2, 575 HP, 2200 V

Feeders

1—24"x10' Jeffrey Pan Feeder
1—24"x5' Denver Adj. Stroke, Belt.



30MNM3D Ingersoll-Rand Slusher

1—24"x6' Denver Adj. Stroke
1—24"x8' Denver Adj. Stroke, Belt.
1—60"x28' Jeffrey Pan Feeder, 15 HP

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1—3'x3" Denver Pan Simplex w/Vacuum
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1—6'—6 disc Oliver, Complete, 3 HP Motor
1—6'—5 disc Oliver, Complete, 1½ HP G. E.
1—6'x6' Oliver, All Stainless, Complete

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1—1 cell Wemco, 44", 5 HP Motor
1—1 cell Denver, #18 Sp. 32" 3 HP Motor
4—2 cell Galigher, 48", 15 HP Motor
1—2 cell Denver, #21, 38"x38"
10—2 cell Fagergren, 56"x56", 14 S.
1—5 cell Wemco, 44", 5 HP Motors
1—5 cell, Denver #18 Sp. 32", 7½ HP
2—3 cell Fagergren, 56"x56", 14 S.

Generators, Diesel

1—75 KW Caterpillar D13,000, 220/440 Volt, Diesel
1—100 KW Caterpillar D13,000, 440 Volt, Diesel

Hoists, Mine Shaft

2—40 HP Coeur d'Alene Single Drum, Excellent
1—75 HP Puget Sound Single Drum
1—170 HP Allis Chalmers Double Drum
1—600 HP Vulcan Double Drum, 2300 V
1—500 HP Nordberg Double Drum, 22000# pull, 2300 V

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2—AAV212 Sullivan, 2 Drum, 15 HP, 220/440 V
1—C-111 Sullivan, 1 drum, 40 HP, 220/440 V
1—30MNM3D Ingersoll Rand, 3 drum, 30 HP, 220/440 V
2—50NM4D Ingersoll Rand, 2 drum, 50 HP, 220/440 V
2—CF211 Sullivan, 2 drum, 50 HP, 440 V
1—50 MNM 4C Ingersoll Rand, 3 drum, 50 HP, 220/440 V
3—FF211 Joy, 2 drum, air
4—S 211 Joy, 2 drum, air
4—A4 NN0J, Ingersoll Rand, 2 drum, air
4—HKE Gardner Denver, 2 drum, air
1—K4U Ingersoll Rand, 1 drum, air, 3000#
5—HK Gardner Denver, 1 drum, air, 2000#
7—HU, Ingersoll Rand, 1 drum, air, 2000#

Jaw Crushers

2—6"x12" Pacific, Type KA
1—8"x10" Denver, Type H, New
1—8"x24" Union Iron Works, 30 HP Motor
1—36"x48" Traylor Bulldog, 125 HP Motor
1—15"x36" Universal, 50 HP G. E. Motor
1—8"x16" Cedar Rapids, Less Motor

Locomotives

17—1½ Ton Mancha Battery, 18-24" ga.
3—1½ Ton Atlas Type J. Battery, 18" ga.
1—2½ 3-Ton Jeffrey, 18" ga.
1—3½ Ton Mancha Titan AX, 18" ga.

Mucking Machines

4—12B Eimco, 24" ga. High or Low Decks
16—GD9 Gardner-Denver, 18"-24" ga.
1—HL3 Sullivan, 18" ga.
5—12B Eimco, 18" ga. Std. Decks
1—21 Eimco, 18" ga.

Screens

1—3'x6' Symons Rod Deck
1—4'x8' Symons Rod Deck
1—18"x36" Denver Dillon Single Deck
1—3'x10' Allis Chalmers Single Deck

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1—Vulcan Single Drum, 10,000# Rope Pull, 510 FPM, Drum 48" Dia., 48" Face, 150 HP West. Motor, 3/60/440.

1—Ottumwa Single Drum, 10,000# Rope Pull, 400/500 FPM, Drum 52" Dia., 20" Face; Motor and controls to suit.

1—Vulcan Single Drum, 7500# Rope Pull, 300/400 FPM, Drum 48" Dia., 36" Face; Motor and controls to suit.

1—Dewco Single Drum, 5000# Rope Pull, 400 FPM, Drum 40" Dia., 23½" Face; Motor and controls to suit.

1—Vulcan Single Drum, 2000# Rope Pull, 225 FPM, Drum 18" Dia., 10" Face; Motor and controls to suit.

2—60" Dia. Card Bicycle Spoke Hoist Sheaves.

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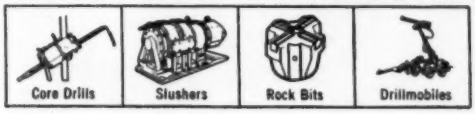

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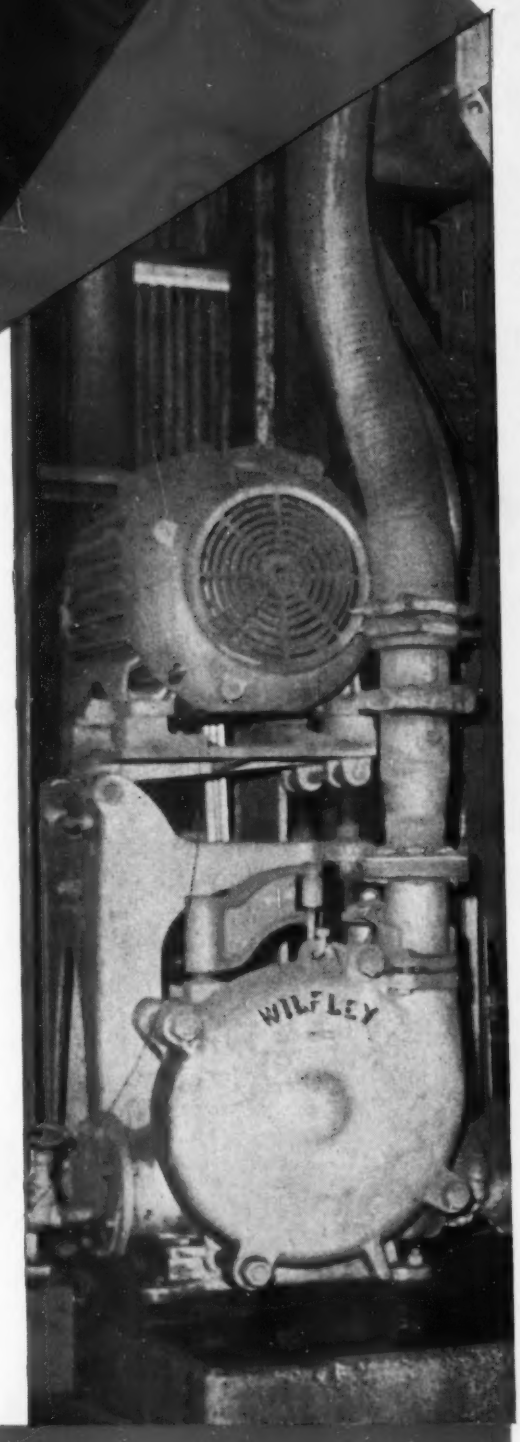

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